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January 12, 1911.

American Machinist

A Practical Journal of Machine Construction

Issued Weekly by the Hill Publishing Company : : : 505 Pearl Street, New York

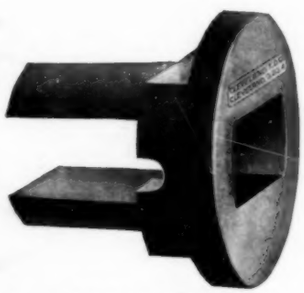
Price 15 Cents, $4.00 per Year

Contents 79. Advertising Index 51

NEW "PARAGON" COLLETS

Provide the strongest drive for large size 'Flatwist' drills

"Paragon" Collet No. 800–A is practically an interchangeable Taper shank for 'Flatwist' drills. The Drive is on the high speed steel tang.



"Paragon" Collet No. 800–B provides a powerful additional drive at the lower and stronger end of the shank by means of the projection which mortises into the spindle.

YOUR heavy duty drilling can be accomplished with precision by using the powerful compact drive provided by these "Paragon" Collets (Patented Nov. 22, 1910.)

THEY allow drilling at higher speeds with absolutely no twisted-off tangs. "Paragon" Collets eliminate cumbersome extension reducing sockets by simply adapting the Nos. 5 and 6 "Paragon" flat taper shanks directly to the drill press spindles.

May we send our folder No. 31-A giving the facts and prices?

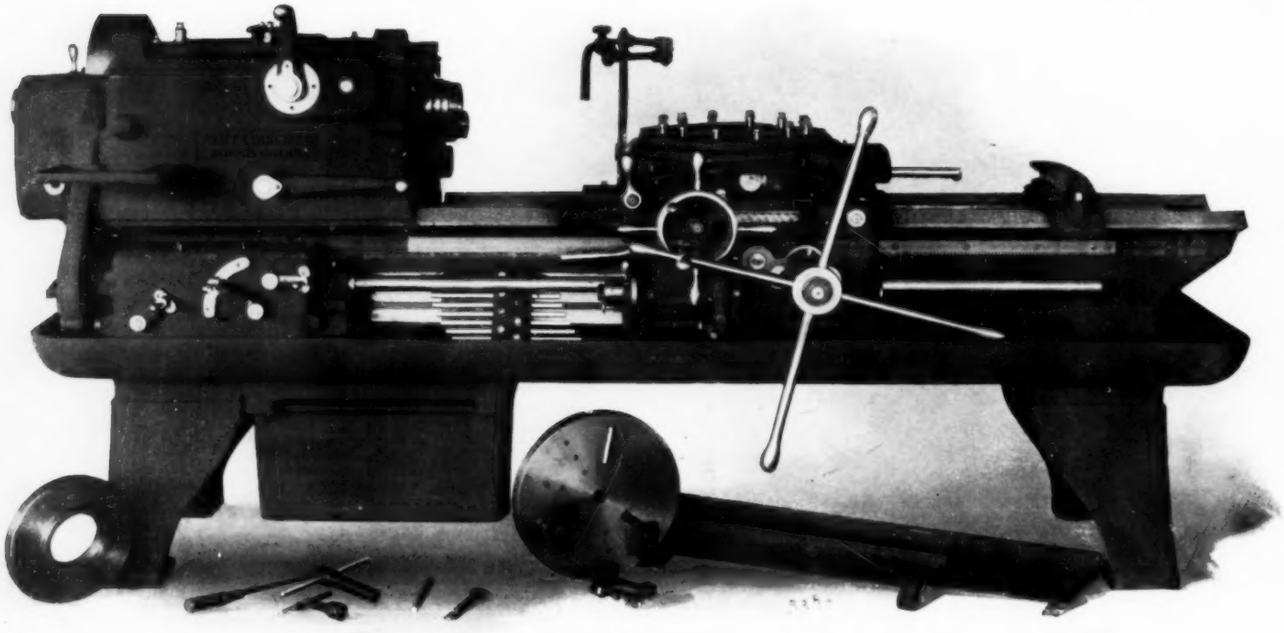
"Paragon" Collet No. 800–B showing its engagement with the spindle—the strongest known drive for 'Flatwist' drills.

The CLEVELAND Twist Drill Co.

New York CLEVELAND, O. Chicago

The Turntable Lathe

With Cross-Sliding Turntable



2½x26-in. Turntable Lathe for castings and forge work.

A Manufacturing Tool

For manufacturing in the strictest sense of the word—every day, and possibly night, an unceasing turning out of work—accurate work—in duplicate—and every piece fully finished and interchangeable.

Such steady work requires a **machine**—a heavily and rigidly constructed machine in which are incorporated all the conveniences of modern practice for increasing production and reducing costs, without jeopardizing accuracy or trying the patience of the operator.

The Turntable Lathe represents the highest combined development of the turret lathe and engine lathe for manufacturing purposes, incorporating some principles that were formerly considered applicable only to precision tools of extreme accuracy. The combination possesses all the flexibility and adaptability of the two without sacrificing the control of one or the accuracy of the other.

For Castings, Forgings and Rod Work

Bar Capacity, 2½ x 26 in. Swing, 20 in.

Pratt & Whitney Company,

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(*See page* 48)

Molding Air-cooled Cylinders

Editorial Correspondence

Locating the flanges in the pattern. The core prints and cores that are used with the method of locating them. Necessity of filling the sand in between the flanges by hand and afterward molding it in a flask in the ordinary way. Special capstan used to draw the pattern from the mold.

While the H. H. Franklin Manufacturing Company, of Syracuse, the manufacturers of the Franklin automobile, are not the first to make air-cooled cylinders, they have adhered to the original scheme and unquestionably have proved the plan a success.

Notwithstanding the fact that the early machines were sufficiently successful to hold their position against the water-cooled engines, nothing was good enough to satisfy them so long as they could see anything that promised better.

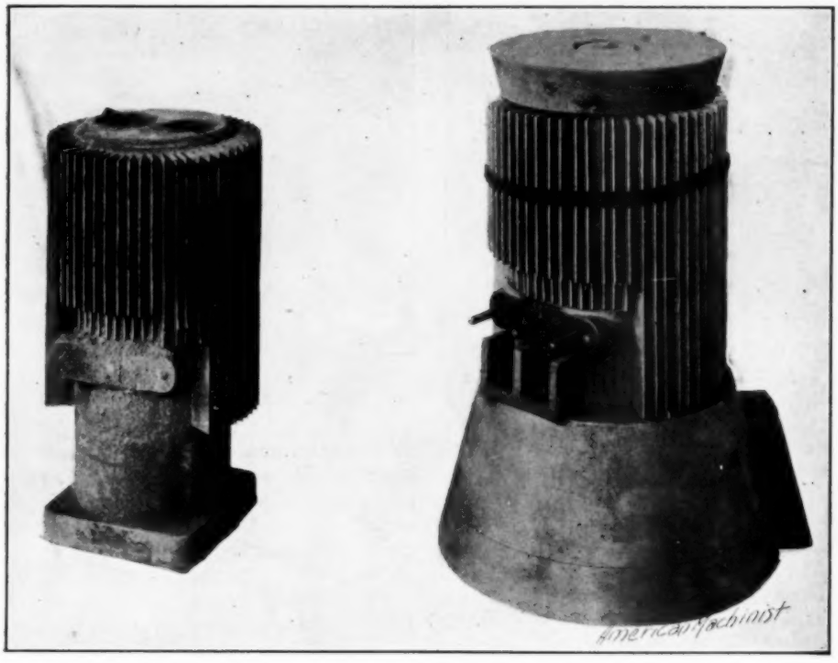


FIG. 1. THE CASTING

FIG. 2. THE COMPLETE PATTERN WITH STEEL FLANGES SET

FIG. 3. PATTERN WITHOUT STEEL FLANGES

THE FLANGES

Originally with them, as with others, the outer cooling surface was increased by flanges projecting horizontally, that is circular flanges. In their 1910 and 1911 machines the projecting flanges or blades are set vertically. This has been done to increase the cooling surface, as well as to enable the outer edges of the flanges to be surrounded by a jacket, so a circulation of air could be drawn down among them. Thus an exceptional quantity of air is brought into contact with the surfaces, with an equal amount of cooling effect on all of the cylinders, and the coldest air is brought into contact with the hottest end of the cylinders.

As it appeared impracticable to cast these cylinders in iron, with their sixty flanges 1/16 inch thick, the plan of casting in steel blades was adopted, as shown in Fig. 1. To explain the method of casting is the reason of this article.

The steel flanges, or blades as they are called in the foundry, are 1/16 inch thick and 1 inch wide. They come tinned, ready to set in the pattern, which they enter about ⅛ of an inch. When set they are all held by a rubber band, as shown in Fig. 2.

THE CORE PRINTS

It will be seen in Fig. 3, which shows the pattern, that there is a core print at each end. The thin one at the top of the cylinder is located in the bottom of the mold and is used for a locating core. The under side of the core is shown

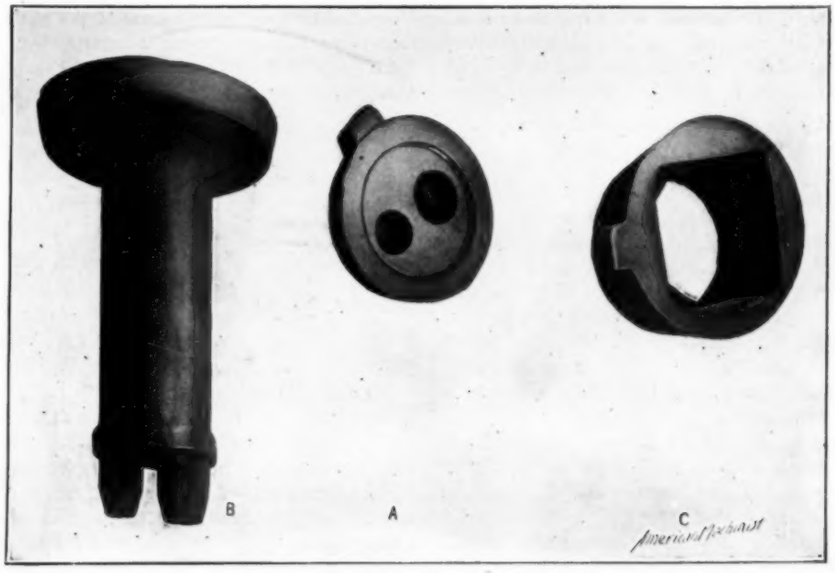


FIG. 4. THREE OF THE CORES

at *A*, Fig. 4, and here will be seen two impressions into which the two projections on the end of the cylinder core *B* are located.

The other or large core print, shown at the bottom in Fig. 3, locates core *C*, Fig. 4. This forms the lower part of the cylinder and has an impression to receive the large flange on cylinder core *B*, and thus locates this end of the cylinder core. The flange is perforated with 18 or 20 ¼-inch holes that form the runners, as shown on its under side, next to the barrel of the core.

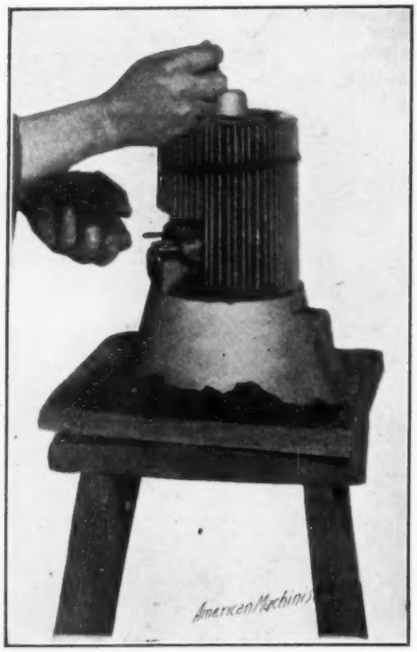


FIG. 5. MOLDER THROWING SAND INTO SPACES BETWEEN FLANGES

PACKING SAND BETWEEN FLANGES

The difficulty that attended the molding was that of getting the sand in between the blades, and this is accomplished by the molders throwing the sand in by hand, as shown in Fig. 5. When this operation is completed the pattern and flanges are as shown in Fig. 6. It is then placed in the flask and rammed as usual.

After ramming the pattern is drawn with a capstan rig, as shown in Fig. 7. The base of this rig is faced off so as to rest squarely on the top ends of the steel blades, and the pattern is pulled up through a central hole which acts like a stripping plate. As will be seen, the pull is by a bicycle chain and sprocket, which acts quickly, and as the sprocket is offset one-half its diameter, the pull is central and direct.

FIG. 6. SAND HAND PACKED BETWEEN FLANGES. PATTERN READY TO ENTER FLASK

FINISHING THE MOLD

The cheek of the flask is then lifted off the lower core print removed and the locating core set. Then as the cheek is replaced and the first part of the upper core set, an electric lamp is introduced into the mold so it may be inspected.

The cylinder core is then set and the running basin built on top.

As will be seen by the view of the pattern there is a projection where the exhaust port is finally cut. This makes a place in the casting much thicker than the balance and this causes a spongy place that shows when the casting is machined. To prevent this an iron chill is sometimes set, and proves to be a successful scheme.

When it is understood that no casting is used that shows the least defect either before or after machining, it will at once be seen that a good system had to be devised or an extra price demanded to pay for wasters. The methods here explained have proved very successful and are done in the foundry of the Straight Line Engine Company. The scheme has been developed by the foreman, Anthony Winter, and one of the molders, Charles Allmang.

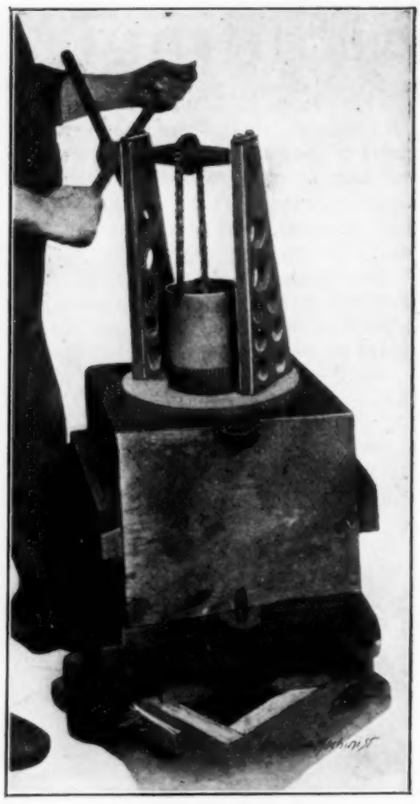


FIG. 7. DRAWING THE PATTERN

Browning Damascus Gun Barrels

BY J. D. MOONEY

A good mixture for browning Damascus gun barrels is composed of the following: ½ ounce muriate tincture of steel; ½ ounce spirits of wine; ⅛ ounce mercury; ⅛ ounce nitric acid; 1/16 ounce blue stone; 1 pint water, soft water preferred.

This should be allowed to stand for a week or two and shook frequently to thoroughly amalgamate the different ingredients.

Slightly tapered wooden plugs should be driven into the ends of the gun barrel and allowed to project about 3 inches. These plugs keep the inside of the barrels dry and also serve for a handle, as finger marks on the barrel would ruin the result.

After driving in the plugs, polish the gun barrels with emery cloth until they are clean and free from all dirt, finger marks and oil spots. After this apply a coat of the browning solution with a sponge that is just dampened with it. A woolen rag may be used in place of the sponge. Then let the barrel stand for from three to five hours. After that apply another coat. After the second coat has thoroughly dried the barrels should be brushed with an unmounted wire scratch brush until all the loose rust has been completely removed. Alternately apply the solution and scratch brush twice daily for from 5 to 10 days.

After the rusting or browning process is deep enough, brush over thoroughly, then for two or three minutes pour boiling-hot water over the entire surface. This will stop all further rusting or browning and the barrels must be wiped dry with a wool rag, and then rubbed with a rag saturated with oil while the barrels are still warm. This makes a true brown color and can only be used on damascus barrels.

Though France claims the invention of the typewriter, practically no typewriters are built in that country.

Remarkable Tool Steel Castings

By E. A. Dixie

Accurate cast tool steel reproductions from intricate wax, plaster of paris, or other patterns. These can be treated the same as regular tool steel.

The AMERICAN MACHINIST has from time to time shown examples of fine castings, in steel, which have been made in foreign countries. It is, of course, difficult to judge the excellence of an article when one sees a halftone only, which at best is two steps removed from the object itself, because a halftone is but a photograph of a photograph. The foregoing fact should be borne in mind when reading this article, for the photographs now in front of me, fine as they are, do not do justice to the most exquisite steel castings I have ever seen. These castings were made by the A. Griffoul & Brothers Company, Newark, N. J. This concern has for years been turning out very high-grade castings in gold, silver, bronze and iron, but recently, after considerable experimental work, has taken up the casting of tool steel for cutting dies and hubs and forces of all kinds and sizes. Any diemaker will appreciate the saving effected by being able to get a tool-steel die cast to shape with but a small amount left to finish.

The samples *A* to *G* are *rough* castings, just as they come from the mold, except that the gates have been broken off. They are all hubs for jewelry dies.

H is a jewelry die made of Crescent tool steel which has been hubbed *cold* in a hydraulic press under 200 tons pressure with the finished hub, shown at *I*. All the hubs shown were cast from either wax or plaster of paris patterns or models, and, no difference how intricate the design may be, the casting is as sharp and perfect as the pattern. The head shown at *B* is 5/16 inch high above the flat face of the casting, while *E* and *F* are ¾ inch high. The method which has been in vogue for the production of jewelry hubs is as follows:

The model is first made in wax by the artist. This model is then either cast in fine, close-grained iron which is finished

REMARKABLE CASTINGS IN TOOL STEEL

by the die sinker and then driven into a block of hot steel; or the model is copied by a die sinker who makes a reproduction of it in tool steel, which is forced into the tool-steel die block, which may be hot or cold. By both of these methods the individuality of the original designer is liable to be lost. Scale forms on the hot-steel die block and this must be removed, and the die finished by the die sinker. Another objection to this method is that the cast-iron hub (which has cost more or less to finish) is generally broken when driven into the block, and should the die itself be damaged in any way, a new cast-iron hub must be made and finished before a new die can be sunk. Where the die sinker makes a tool-steel hub the cost is considerable, and unless he is an artist as well as a craftsman, the artistic touch of the designer is lost.

The cast-steel hub, however, is made direct from the artist's own model, or a plaster of paris reproduction of it. The mold reproduces the pattern faithfully in every detail. The steel hub must, of course, be finished by the die sinker, but the *character* is in it when it reaches his hands, and all he has to do is to smooth up the surfaces left slightly rough by the very fine sand of the mold, his is merely a smoothing and not a cutting operation.

The castings are of Darwin Milner & Company's steel, and are run with very large gates, as will be seen in the illustrations. The castings come from the sand very hard, but are easily annealed in the usual way, and take no longer to anneal than a piece of bar steel of the same size. When annealed they are very soft, and cut like a good grade of machinery steel. After finishing they are heated to between 1400 and 1500 degrees Fahrenheit and hardened in fish oil. The hub shown at *I* was hardened in water, and drawn to a pale straw color. Hardening in water, however, is not recommended, especially so for large dies. The shrinkage in casting is about the same as for cast iron, but in hardening and tempering, it is said that the steel does not alter either in size or shape.. Hydraulic forging dies are made by the same concern and experiments are now being made with drop-forge dies in view.

Cutting Turbine Reduction Gears

EDITORIAL CORRESPONDENCE

About a year ago engineering circles were much interested in the announcement of the building and tests of the Melville-McAlpine steam-turbine reduction gear intended for use on shipboard. The device was developed, built and tested by the Westinghouse Machine Company, Pittsburg, Penn., with the exception that the gears and pinions were made in Germany.

It is now a matter of especial interest that several reduction gears are under construction by the above named firm and the gears and pinions themselves are being cut at East Pittsburg. Figs. 1 and 2 show both a right- and left-hand gear in process of being cut, while Fig. 3 shows another gear in process with the roughing cut nearly completed. This is taken from such a position that the action of the hob is plainly shown.

The hobbing machine is a Pfauter, furnished by Schuchardt & Schütte. The hobs used are imported Pfauter hobs. The gears shown are something over 8 feet in diameter and have a face width of 17 inches. The corresponding pinions are about 12 inches in diameter.

The speed of rotation is such that 7¼ minutes are required to make one revolution of the gear, while the cutting is at such speed that 98 hours are required to finish one of the gears. Two cuts are used, a roughing and a finishing.

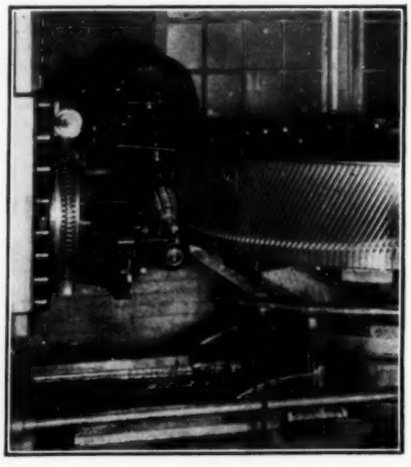


FIG. 3. ANOTHER VIEW, SHOWING THE HOB IN ACTION

There was recently cast at the plant of the Carnegie Steel Company what is supposed to be the largest ingot ever cast. It measured 40 inches thick, by 140 inches wide by 168 inches long and weighed 326,000 pounds. This ingot was forged into a Krupp-armor plate 18 inches thick and will weigh about 160,000 pounds finished. This plate is one of a pair of port plates for the 14-inch open turrets for a land fortification for the army, and it is claimed will no doubt be the strongest fortification in the world.

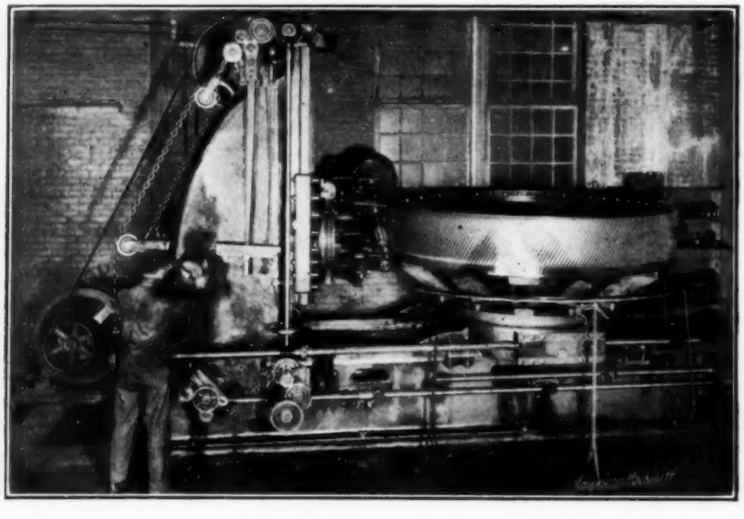
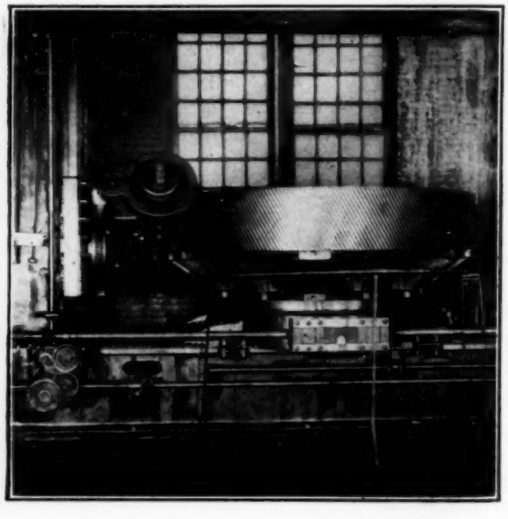


FIG. 1. CUTTING HELICAL GEARS FOR REDUCTION GEAR OF A UNITED STATES COLLIER FIG. 2.



Forming Screw Conveyer Flights

By Otto S. Beyer

A problem in sheet metal work for which the rule of thumb methods of a so-called expert were found entirely inadequate.

Cutting the blank to "find the missing metal".

Peculiar action of apparently perfectly formed dies.

The stamping of steel screw-conveyer flights is an old art, such conveyers being well known and a staple article in the market; but few people realize the intricacies and problems that had to be battled with in the development of this line of sheet-metal work. It may, therefore, be not without interest to the readers of the AMERICAN MACHINIST to hear of the course of evolution through which the writer had to progress some years ago, when coping with an order to produce a small number of conveyer flights of such specifications as could not be procured from the regular makers.

The order called for 50 flights, outer diameter 15 inches, inner diameter 2½ inches, pitch 12 inches and thickness of metal 5/32 inch. They had to be very accurate in every particular, fitting snugly over the shaft and also the inside of the conveyer tube, and, when assembled, they should form a perfect screw. As a matter of course, time of delivery was "of considerable moment."

At first sight the job appeared simple enough, and when a consultation with the foreman in the shop disclosed the fact that among the men under him there was an "expert" on conveyer flights, who had for a number of years worked for a firm engaged in the manufacture of steel screw-conveyers, and who "knew all about it," the job was turned over to this expert. His plan was; first, to "find the blank" (which he knew exactly how), then to bend the blanks in a preliminary way by hand, and to finish them by a suitable set of cast-iron dies under a drop hammer; all of which sounded quite reasonable.

Several days had elapsed when the foreman, upon inquiring as to how the expert was getting along with this job, stated: "Quite well; only, the man is having some trouble bringing up the inner edge of the flights, because of the small diameter of the shaft over which they have to fit." A visit was paid the expert at his work bench. He showed several slitted ring blanks, such as that illustrated by Fig. 8 of the accompanying sketches, which had their outer diameters and center holes the very same dimensions the finished flights were to have. Some of the ring blanks he had attempted, with the aid of clamps, a vise, a 2½-inch arbor and a mallet, to form into helices of 12 inches pitch, "to find the missing metal." Of course, no coaxing or hammering would bring the inner edge of the helix anywhere near the points *b b*, in Fig. 4; the arbor was badly scratched, nor would the battered things that he had hammered out, furnish any clue whatsoever to the final shape of the blank. Evidently the expert's observations in the screw-conveyer maker's shop had not rooted very deeply in his memory, and it became imperative to relieve him of the " blank finding" end of the job and to give it some consideration over the drawing board.

The blank then evolved and adopted is shown by Fig. 7, and in isometrical perspective by Fig. 3. Its shape and dimensions were arrived at by the following deductions: First, the fact was ascertained, that in the transportation of a flat ring blank into a helix in the manner contemplated, no appreciable stretch or compression of the metal could occur, as only slight bending, or rather distortion, could take place; therefore, the governing dimensions and outlines of the blank must correspond as nearly as possible to those of the finished helix.

With this fact in view, the hole in the ring blank was next considered, its size governing the length of the inner edge of the helix, with which the "expert" had had the most trouble. The length of the inner edge of the helix was figured out and the hole made of such size that its periphery equalled that length. The calculation is very simple.

The length of the inner edge of the helix equals the square root of the sum of the square of the pitch (12 inches) and the square of the periphery of the arbor around which the helix has to fit ($2\frac{1}{2}\pi$), or

$$L = \sqrt{12^2 + (2\tfrac{1}{2}\pi)^2} = 14.34 \text{ inches.}$$

The diameter of the circle having a periphery of 14.34 inches is 4 9/16 inches, and this diameter was adopted for the hole in the ring blank.

The size of the hole in the blank settled, the more vexing question regarding the outer diameter of the blank came up for consideration. With the fact still in view that there can occur no appreciable stretch or compression of the metal when transformed from a flat ring into a helix, it was self evident that the width of the metal in the ring blank should be equal to the width of the metal strip of the helix, which in the present case was 6¼ inches. This width was, therefore, settled upon and the outer diameter of the ring blank made 17 1/16 inches. However,

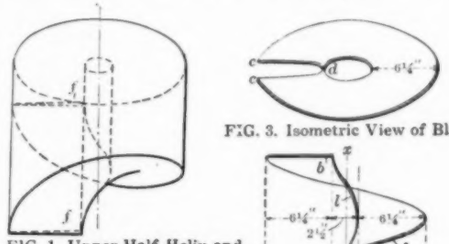


FIG. 1. Upper Half Helix and Method of Relief of Die.

FIG. 3. Isometric View of Blank.

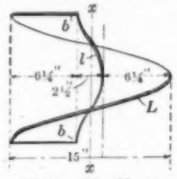


FIG. 4. The Sheet Metal Helix Desired.

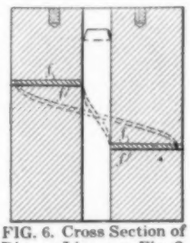


FIG. 6. Cross Section of Dies on Line *y-y*, Fig. 2.

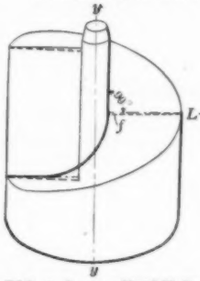


FIG. 2. Lower Half Helix and Relief of Die.

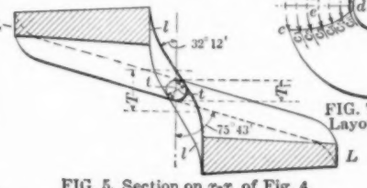


FIG. 5. Section on *x-x*, of Fig. 4. Thickness of Stock Exaggerated.

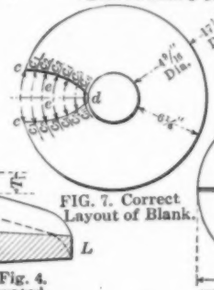


FIG. 7. Correct Layout of Blank.

FIG. 8. Wrong Form of Blank.

American Machinist

FORMING A SHEET-METAL HELIX

the periphery of a blank of this diameter is considerably longer than the outer edge *L* of the required helix, as shown by the following figures:

Periphery of a circle of $17\frac{1}{16}$ inches diameter ... = 53.604 inches.

L = length of outer edge of 15-inch helix = $\sqrt{12^2 + (15\pi)^2}$ ..... = 48.628 inches

Excess of periphery over *L* ..... = 4.976 inches.

For a graphical illustration, this distance of 4.976 inches was stepped off on the periphery of the blank (as shown by the dot and dash line *c c*, Fig. 7), when it became quite apparent that a ring blank of 17 1/16 inches outer diameter and 4

9/16-inch hole contained a surplus of metal of some triangular shape, bounded by lines between points *c c* and a point *d* on the periphery of the hole and opposite the middle of *c c*.

The shape of this triangular piece of surplus metal was found by scribing on the blank concentric circles 1 inch apart, figuring the differences between their peripheries and the lengths of the corresponding helices they would describe when the flight would be formed, and stepping off these differences on the respective circles, half on each side of a line drawn from point *d* to the middle of *c c*. Thus the points c_1, c_2, c_3, etc., were established and joined by curved lines, as shown. The metal bounded by these lines was then cut from the ring, cutting through at *d*, which completed the blank.

In the meantime, and still by the directions of the "expert," the patternmaker had made a very carefully worked-out pattern from which the lower half-die, shown by Fig. 2, was produced. This die and the mallet were used in testing the the above described blank. The required helix was easily formed, and the blank proved all that was expected of it.

Then the upper half-die, shown by Fig. 1, arrived from the machine shop. Like the first delivered, lower half, it looked like a good job, the two halves fitting each other perfectly, so that everything seemed favorabe to a speedy and satisfactory completion of the order. But it was not thus to be, for when attempting to shape in the die a blank that was beforehand worked into approximately final shape, the upper and lower dies refused to come together; or rather, they would not strike all over the blank. On the contrary, there was at the outside a considerable gap left between blank and die-halves, and the resulting product in its buckled state was anything but pretty to look at. The expert could not explain, and suggested chipping the upper die half until it would come down hard all over the flight, for "so they always had to do with new dies in the shop where they make such flights by the millions."

That dressing of the dies was needed, was clear enough; but where to begin? how much? and why? An examination of the dies showed apparently perfect conditions; the developing radius of the helix was straight throughout and square with the spindle, the helices correct in both the lower and upper halves, the latter having been cast from a plaster of paris cast that was carefully prepared of the face of the first pattern. Both halves came perfectly together when there was no blank between them; in all, the die appeared to be a job very creditable to both the pattern and machine shops.

No clue to the trouble could be found, and once more recourse was had to the drawing board. This is what was found: The outer edge of the desired helix stands to the axis at an angle of 73 degrees 43 minutes, the inner edge, however, stands to the axis at an angle of only 32 degrees 12 minutes; as the die halves approach each other in the direction of the axis, it follows that the metal at the outer edge of the helix is struck at a more obtuse angle than that at the inner edge, as will become quite clear by reference to Fig. 5, which shows an exaggerated cross section of the finished helix taken on line *x x*, Fig. 4.

This view explains fully why the die halves that fitted each other so well when there was no blank between them, and wherein the helix developing radius was always square with the axis, could not come down and strike all over when a blank of some thickness was placed between them. Although the thickness *t*, of the metal, was practically uniform throughout the blank, the metal presented itself to the dies at angles differing along the developing radius, and the distances between opposing striking points increased with the sharpness of the angles; that is, from the outer to the inner edge, the difference between the two extremes being considerable. The distance between striking points being the greatest at the inner edge, of course, the metal was here reached first by the dies, and as it could not be dislodged, it kept the die halves apart and prevented them from touching any other part of the blank.

The distances between striking points at the several places easily can be figured from the angle under which the metal is struck. It equals the thickness of the metal, divided by the sine of the striking angle. This we got in our case at the inner edge of the helix, between the sinking points, a distance $T = 0.2934$ inch, and at the outer edge a distance $T_1 = 0.1612$ inch, the difference between the two being 0.1322 inch.

Thus, a measure was found for the dressing of the two die halves. The lines *f f* in Figs. 1, 2 and 6, denote what had to be done. Actually the dies were chipped off somewhat in excess of the theoretical amount, to allow for possible irregularities in the thickness of the metal, and the results obtained left nothing for unfavorable comment.

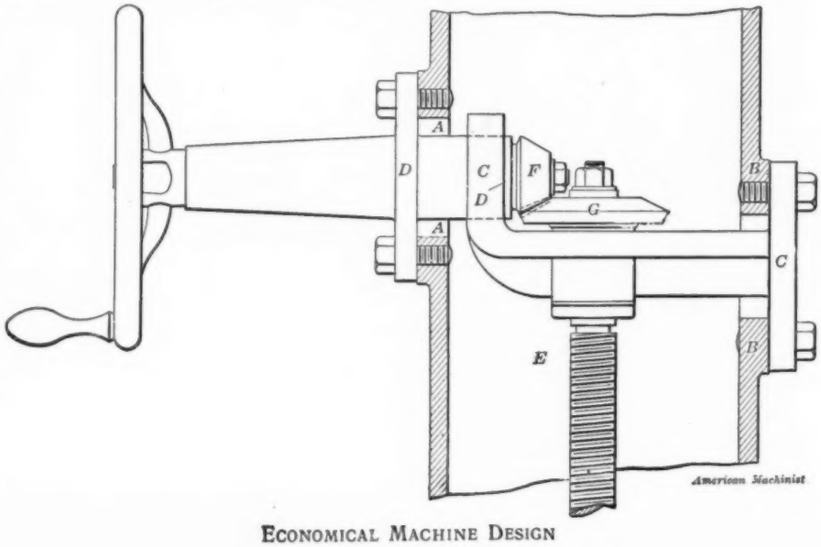
It may be added that, throughout the above deductions the theory of coil springs made from square stock served as a useful guide, as the stretching of such a spring and the forming of a flat ring blank into a helix are governed by analogous laws.

Economical Machine Design

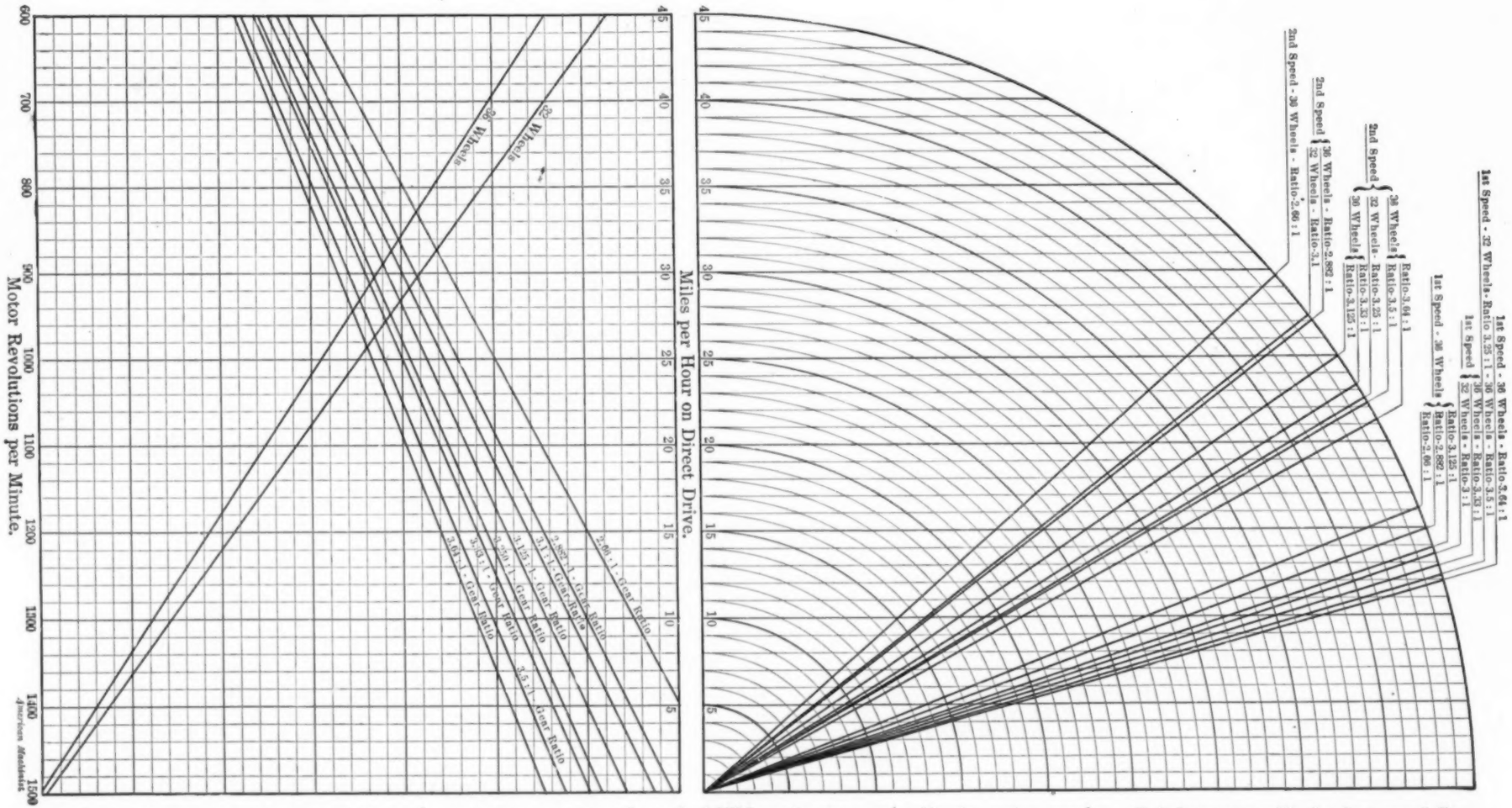
Every mechanic knows the difficulty and expense of machining inside surfaces by back facing, or similar operations, far better than draftsmen and designers, who have never been up against the shop end of machine building. It is much easier to finish surfaces on paper than on the metal itself.

The accompanying illustration shows a section of a machine column, in which it is necessary to support bevel gears, and indicates how this was done without any machining of the inside faces of the column itself.

The outside surfaces *A A* and *B B* were faced off to receive the interlocking supports *C* and *D*. The support *C* has a hole for the elevating screw *E*, and also takes the thrust of the bevel gear *G*. Its outer end is bored to receive the front end of the sleeve *D*, which projects through and is supported by it, as shown. This forms a bearing for the pinion *F* and holds it firmly in mesh with the gear *G*, the two pieces being interlocked so as to insure rigidity and perfect alinement of both the gears and the elevating screw.



ECONOMICAL MACHINE DESIGN


Motor Revolutions per Minute.
600
700
800
900
1000
1100
1200
1300
1400
1500
American Machinist
Miles per Hour on Direct Drive.
45
40
35
30
25
20
15
10
5
36 Wheels
32 Wheels
2.80 : 1 - Gear Ratio
3.125 : 1 - Gear Ratio
3.33 : 1 - Gear Ratio
3.5 : 1 - Gear Ratio
3.64 : 1 - Gear Ratio
2nd Speed - 36 Wheels - Ratio-2.80 : 1
2nd Speed { 36 Wheels - Ratio-3.1 / 32 Wheels - Ratio-2.882 : 1
2nd Speed { 36 Wheels - Ratio-3.33 : 1 / 32 Wheels - Ratio-3.125 : 1
2nd Speed { 36 Wheels - Ratio-3.5 : 1 / 32 Wheels - Ratio-3.25 : 1
2nd Speed { 36 Wheels - Ratio-3.64 : 1 / 32 Wheels - Ratio-3.5 : 1
1st Speed - 32 Wheels - Ratio 3.25 : 1 - 36 Wheels - Ratio-3.5 : 1
1st Speed { 36 Wheels - Ratio-3.33 : 1 / 32 Wheels - Ratio-3 : 1
1st Speed - 36 Wheels { Ratio-3.125 : 1 / Ratio-2.882 : 1 / Ratio-2.80 : 1

Speed Chart for Automobiles

By J. Coapman

Those interested in motor-car design often want to know just what gear ratio is required to drive a car at a certain predetermined speed with the revolutions per minute of the motor known. I therefore worked out the accompanying chart for that purpose.

As an example we will suppose that the motor runs at a normal speed of 1000 revolutions per minute, the wheels are 32 inches in diameter and we desire to know the speed on high or direct drive. At 1000 on the lower line of the chart trace the vertical line until it intersects the line for the gear ratio used (say, 3: 1), then move horizontally until the 32-inch wheel line is intersected, and then vertically to the top of the lower chart. This will show 32 miles per hour. If 36-inch wheels and 3½: 1 bevel-gear ratio are used with the motor running 900 revolutions per minute, a reading of about 27¾ miles per hour will be obtained. If the motor is assumed to run 1200 revolutions per minute we will obtain a reading of 37 miles per hour.

The upper chart is for intermediate and low gear. For the first example, if the first speed, which is the low, is desired, do not stop at the 32 miles, but jump the gap between the two charts and follow the arc directly opposite until it intersects with the first speed line for 32-inch wheels at the 3: 1 ratio. Then following the vertical line downward will give a reading of 9½ miles per hour. On second or intermediate speed we would get 19½ miles per hour.

For the second example on first speed we get 7½ and on second speed 14½ miles per hour. With a motor speed of 1200 revolutions per minute we read 10 miles per hour on first and 18½ miles per hour on second speed.

All the work to be done on both *C* and *D* is perfectly plain, and simply involves accurate laying out in this case, although if a sufficient number were made, it would be easy to provide fixtures which would shorten the time required.

We are indebted to the Beaman & Smith Company, Providence, R. I., for the illustration, which shows one of their problems and the way in which it was solved in a simple and highly satisfactory manner.

Cutting Plate Cams on Milling Machine

By R. F. Biesemeier*

By inclining dividing head and milling spindle of universal miller, it is possible to cut cam leads intermediate between those for which the machine may be geared.

Tables of gearing and angles of inclination for leads between 0.075 and 5 inches.

*Instructor in machine work Lewis Institute, Chicago, Ill.

This article has particular reference to the making of plate cams for the No. 0 and No. 00 Brown & Sharpe automatic screw machine.

No doubt all are more or less familiar with the ordinary method of cutting cams on the milling machine, that is with the milling spindle and the dividing head set vertical and the machine geared for the required lead. But the alternation of leads by inclining the dividing head and milling spindle, is not so well understood.

With the head set vertically, the lead of the cam would be the same as that for which the machine is geared; but with the head and spindle set horizontally, a concentric arc or rest would be milled regardless of how the machine was geared. With the index head and milling spindle set at an angle, we can obtain any lead less than that for which the machine is geared; that is, the lead obtained for any angle of inclination equals the cosine angle of inclination times lead for which the machine is geared.

$$\left.\begin{array}{l}\textit{Lead, in inches,}\\ \textit{to one turn of}\\ \textit{cam blank}\\ \textit{when head is}\\ \textit{set vertical}\end{array}\right\} = \frac{10 \times \textit{worm gear} \times \textit{2d stud gear}}{\textit{screw gear} \times \textit{1st stud gear}}$$

The method used to find the angle of inclination at which to set the dividing head and milling spindle to alter the lead, is shown in Fig. 1.

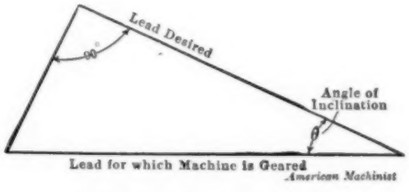


FIG. 1. RELATION OF LEADS

By trigonometry we have:

$$\left.\begin{array}{l}\textit{Cosine angle}\\ \textit{inclination}\end{array}\right\} = \frac{\textit{lead desired}}{\textit{lead for which machine is geared}}.$$

By referring to the plate cam in Fig. 3, we find that the leads required are three. In a case of this kind it is more convenient to use the inclination method. We gear the machine up for a lead greater than the longest one given, and then all can be milled with the same set of change gears, simply by altering the inclination of the head and spindle.

For illustration; take the plate cam in Fig. 3. The leads given are 0.585, 0.200 and 0.580 inch. Select some lead which is greater than the above, for which the machine can be conveniently geared; say, in this case, we take 0.600 inch. The gears required may be taken from the table, but for example we will find them as follows:

$$0.600\ \textit{inch} = \frac{600}{1000},$$

and

$$\frac{\textit{lead desired}}{\textit{natural lead of machine}} = \frac{600}{1000 \times 10} = \frac{600}{10{,}000}.$$

This is the ratio for which the machine must be geared. The natural lead of most milling machines is 10 inches, and

$$\frac{600}{10{,}000} = \frac{3}{50} = \frac{3}{10} \times \frac{1}{5};$$

$$\frac{3}{10} \times \frac{8}{8} = \frac{24}{80} = \textit{worm gear} \div \textit{1st stud gear}.$$

$$\frac{1}{5} \times \frac{24}{24} = \frac{24}{120} = \textit{2d stud gear} \div \textit{screw gear}.$$

$$\frac{3}{50} = \frac{24 \times 24}{120 \times 80} = \frac{\textit{worm gear} \times \textit{2d stud gear}}{\textit{screw gear} \times \textit{1st stud gear}}.$$

See Fig. 2 for set up of gears.

To find the angles for each setting, we use the formula given above.

Angle θ to which to set head for lead of 0.585 inch:

Cosine $\theta = 0.585 \div 0.600 = 0.975$. Referring to table of cosines, we find $\theta =$ 12 degrees 50 minutes.

Angle θ to which to set head for lead of 0.200 inch:

Cosine $\theta = 0.200 \div 0.600 = 0.333$. Angle θ = 70 degrees 30 minutes.

Angle θ for lead of 0.580 inch:

Cosine $\theta = 0.580 \div 0.600 = 0.966$. Angle θ = 14 degrees 50 minutes.

When the inclination of the head will admit, it is best to mill on the under side of

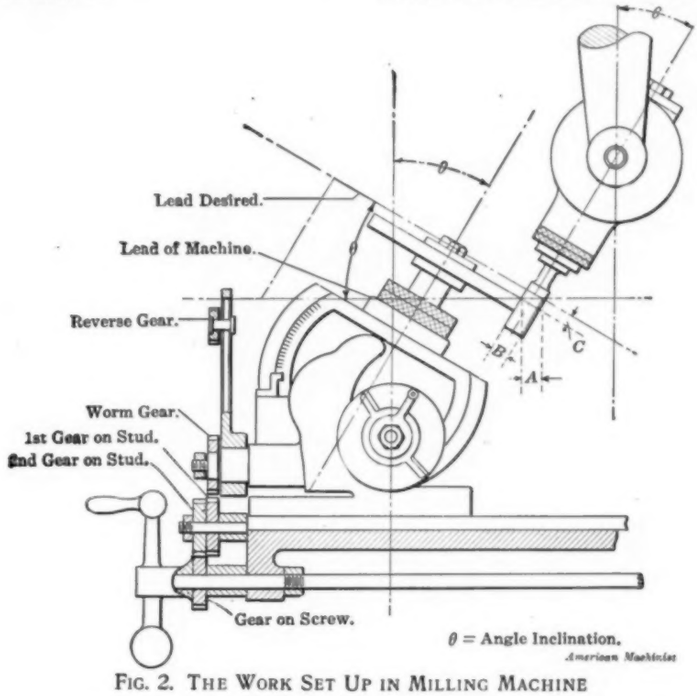


FIG. 2. THE WORK SET UP IN MILLING MACHINE

TABLE 1. LEADS FROM 0.975 TO 0.249 INCH.

For all the given leads less than 0.249 inch, the angle of inclination of spindle and head are tabulated. The gears used are those given for lead of 0.249 inches.

Lead in Inches.	Angle of Inclination.	Lead in Inches.	Angle of Inclination.
0.075	72°—28′	0.170	46°—56′
0.080	71°—15′	0.175	45°—21′
0.085	70°— 2′	0.180	43°—42′
0.090	68°—49′	0.185	41°—40′
0.095	67°—34′	0.190	40°—16′
0.100	66°—19′	0.195	38°—27′
0.105	65°— 3′	0.200	36°—34′
0.110	63°—47′	0.205	34°—35′
0.115	62°—30′	0.210	32°—30′
0.120	61°—11′	0.215	30°—18′
0.125	59°—52′	0.220	27°—26′
0.130	58°—32′	0.225	25°—22′
0.135	57°—10′	0.230	22°—32′
0.140	55°—47′	0.235	19°—18′
0.145	54°—23′	0.240	15°—27′
0.150	52°—56′		
0.155	51°—30′	0.249 , worm 24, 1st stud 142, 2d stud 23, screw gear 156.	
0.160	50°— 1′		
0.165	48°—30′		

TABLE 2. LEADS FROM 0.249 TO 5.000 INCHES.

Gears used in this table are as follows: 23, 24, 24, 25, 26, 28, 32, 34, 36, 40, 44, 48, 56, 64, 72, 80, 86, 100, 120, 128, 142, 156.

Leads.	Gear on Worm.	1st Gear on Stud, and Angle of Inclination.	2nd Gear on Stud.	Gear on Screw.
0.249	24	142	23	156
0.250	..	15°—56′	..	...
0.255	..	11°—15′	..	...
0.260	24	142	24	156
0.265	..	11°— 3′	..	...
0.270	26	142	23	156
0.276	24	128	23	156
0.282	26	142	24	156
0.288	25	128	23	156
0.291	28	142	23	156
0.295	24	120	23	156
0.300	25	128	24	156
0.304	24	128	23	142
0.308	24	120	24	156
0.316	28	142	25	156
0.321	25	120	24	156
0.326	26	128	25	156
0.330	25	128	24	142
0.333	26	120	24	156
0.338	24	120	24	142
0.344	28	120	23	156
0.351	26	142	23	120
0.354	28	128	23	142
0.359	24	128	23	120
0.365	28	128	26	156
0.370	28	128	24	142
0.375	24	120	24	128
0.381	26	120	25	142
0.385	28	128	25	142
0.390	36	142	24	156
0.394	28	120	24	142
0.400	32	128	23	142
0.410	32	120	24	156
0.415	36	128	23	156
0.421	26	100	23	142
0.426	34	128	25	156
0.430	34	128	23	142
0.436	34	120	24	156
0.440	32	128	25	142
0.444	32	120	26	156
0.450	24	100	24	128
0.455	34	142	28	156
0.460	24	100	23	120
0.465	26	86	24	156
0.469	32	120	25	142
0.475	36	128	24	142
0.480	24	100	24	120
0.485	26	86	25	156
0.490	26	86	23	142
0.495	36	128	25	142
0.500	25	100	24	120
0.505	36	128	28	156
0.509	34	120	23	128
0.515	36	128	26	142
0.520	26	100	24	120
0.525	28	100	24	128
0.531	36	100	23	156
0.535	24	86	23	120
0.540	24	72	23	142
0.545	25	86	24	128
0.550	28	86	24	142
0.555	36	128	28	142
0.560	28	100	24	120
0.567	34	100	26	156
0.572	32	86	24	156
0.575	24	80	24	120
0.580	26	86	23	120
0.585	26	72	23	142
0.590	26	86	25	128
0.596	32	86	25	156
0.600	24	80	24	120
0.605	26	86	24	120
0.610	26	72	24	142
0.615	32	80	24	156
0.620	32	86	26	156
0.625	24	72	23	142
0.630	28	72	23	142
0.635	26	80	25	128
0.640	32	100	24	120
0.646	36	100	28	156
0.650	26	80	24	120
0.655	32	86	25	142
0.659	36	100	26	142
0.664	34	100	25	128
0.670	24	86	24	100
0.675	36	100	24	128
0.680	34	100	24	120
0.685	28	72	25	142
0.690	24	80	23	100
0.695	26	86	23	100
0.700	28	80	24	120
0.705	26	72	25	128
0.710	34	86	23	128
0.713	32	86	23	120
0.720	24	80	24	100
0.726	26	86	24	100
0.729	28	80	25	120
0.737	23	72	32	156
0.741	26	72	32	156
0.745	23	72	28	120
0.750	24	80	32	128
0.756	26	86	25	120
0.760	25	72	28	128
0.765	23	72	34	142

Leads.	Gear on Worm.	1st Gear on Stud, and Angle of Inclination.	2nd Gear on Stud.	Gear on Screw.
0.769	36	72	24	156
0.775	32	86	25	120
0.780	26	80	24	100
0.785	36	86	24	128
0.790	28	72	26	128
0.797	34	80	24	128
0.800	24	72	24	100
0.805	28	80	23	100
0.810	28	72	25	120
0.815	34	80	23	120
0.818	36	86	25	128
0.825	36	86	28	142
0.830	34	80	25	128
0.836	25	80	23	86
0.840	28	80	24	100
0.845	36	72	24	142
0.850	34	80	24	120
0.856	32	86	23	100
0.862	36	80	23	120
0.865	34	72	26	142
0.869	26	80	23	86
0.875	28	80	25	100
0.880	36	72	25	142
0.885	34	80	25	120
0.891	34	86	32	142
0.894	23	72	23	100
0.900	24	64	24	100
0.905	34	72	23	120
0.910	28	80	26	100
0.915	36	72	26	142
0.920	32	80	23	100
0.926	32	72	25	120
0.930	24	72	24	86
0.936	28	80	23	86
0.938	36	72	24	128
0.945	26	80	25	86
0.949	34	86	24	100
0.958	34	80	32	142
0.960	32	80	24	100
0.963	36	86	23	100
0.969	25	72	24	86
0.975	36	80	26	120
0.981	36	80	24	156
0.984	36	80	28	128
0.988	34	86	25	100
0.992	34	80	28	120
1.000	32	80	25	100
1.005	36	86	24	100
1.011	28	72	26	100
1.016	36	72	26	128
1.020	34	80	24	100
1.029	24	56	24	100
1.035	36	80	23	100
1.040	32	80	26	100
1.047	24	64	24	86
1.050	24	64	28	100
1.054	34	86	32	120
1.058	28	80	26	86
1.064	34	72	32	142
1.070	32	86	23	80
1.077	36	120	56	156
1.080	36	80	24	100
1.085	24	72	28	86
1.090	36	72	34	156
1.094	36	72	28	128
1.102	34	72	28	120
1.105	34	80	26	100
1.111	32	72	25	100
1.116	24	86	40	100
1.120	32	80	28	100
1.125	36	80	25	86
1.131	28	72	25	100
1.133	34	72	24	86
1.137	34	80	23	86
1.145	32	86	48	156
1.150	36	72	23	100
1.156	32	72	26	100
1.163	32	80	25	86
1.167	36	72	28	120
1.170	36	80	26	100
1.176	28	72	26	86
1.181	34	72	25	100
1.186	34	80	24	86
1.190	34	80	24	100
1.195	36	80	34	128
1.200	24	64	32	100
1.204	36	80	23	86
1.209	26	86	40	100
1.215	28	72	25	80
1.221	24	64	28	86
1.226	36	64	34	156
1.228	24	86	44	100
1.236	34	80	25	86
1.240	24	72	32	86
1.245	32	72	28	100
1.250	24	64	24	72
1.256	36	80	24	86
1.260	36	80	28	100
1.265	34	86	32	100
1.270	26	80	25	64
1.275	36	80	34	120
1.278	32	72	23	80
1.285	34	80	26	86
1.292	32	72	25	86

Leads.	Gear on Worm.	1st Gear on Stud, and Angle of Inclination.	2nd Gear on Stud.	Gear on Screw.
1.296	32	40	23	142
1.300	36	72	26	100
1.302	28	86	40	100
1.309	24	44	24	100
1.312	36	64	28	120
1.318	34	72	24	86
1.323	28	64	26	86
1.328	36	72	34	128
1.333	24	72	40	100
1.340	24	86	48	100
1.344	32	72	26	86
1.350	36	100	24	64
1.354	26	64	24	72
1.360	34	80	32	100
1.362	34	40	25	156
1.375	48	80	23	100
1.380	24	40	23	100
1.384	34	80	28	86
1.389	32	72	25	80
1.395	24	64	32	86
1.400	28	64	32	86
1.406	36	64	25	100
1.410	26	72	25	64
1.417	34	72	24	80
1.421	34	86	23	64
1.423	36	86	34	100
1.429	24	56	24	72
1.433	28	86	44	100
1.440	24	40	24	100
1.445	32	72	26	80
1.447	28	72	32	86
1.454	36	72	25	86
1.458	24	64	28	72
1.465	36	80	28	86
1.473	24	56	44	128
1.476	34	72	25	80
1.481	64	72	26	156
1.483	34	64	24	86
1.488	32	86	40	100
1.495	26	40	23	100
1.500	24	64	40	100
1.505	26	36	25	120
1.511	34	72	32	100
1.514	34	36	25	156
1.521	36	80	48	142
1.527	24	44	28	100
1.530	36	80	34	100
1.535	34	72	26	80
1.538	34	72	28	86
1.544	34	64	25	86
1.550	24	72	40	86
1.556	28	72	40	100
1.560	26	40	24	100
1.563	28	86	48	100
1.570	36	64	24	86
1.575	36	64	28	100
1.581	34	80	32	86
1.585	36	40	25	142
1.592	36	72	26	80
1.595	24	56	32	86
1.600	24	72	48	100
1.607	24	56	24	64
1.610	56	80	23	100
1.615	36	80	56	156
1.620	..	4°—30′	..	...
1.625	32	64	26	80
1.628	28	64	32	86
1.635	36	86	25	64
1.640	24	32	28	128
1.648	72	80	26	142
1.650	24	64	25	80
1.653	34	72	28	80
1.660	34	64	25	80
1.667	24	64	32	72
1.671	25	40	23	86
1.674	36	86	32	80
1.680	24	40	28	100
1.685	56	72	26	120
1.690	36	72	48	142
1.695	34	72	56	156
1.700	36	72	34	100
1.706	24	72	44	86
1.711	28	72	44	100
1.714	24	56	40	100
1.717	36	86	64	156
1.725	72	80	23	120
1.730	34	86	28	64
1.736	32	86	56	120
1.744	24	64	40	86
1.745	24	44	32	100
1.750	28	64	40	100
1.757	34	86	32	72
1.771	34	64	24	72
1.775	34	80	64	142
1.776	24	44	28	86
1.779	36	80	34	86
1.786	32	86	48	100
1.789	56	72	23	100
1.795	36	72	56	156
1.800	24	32	24	100
1.805	32	64	26	72
1.809	28	72	40	86
1.813	34	100	64	120
1.818	24	44	24	72

TABLE 2. LEADS FROM 0.249 TO 5.000 INCHES.—*(Continued)*

Leads.	Gear on Worm.	1st Gear on Stud, and Angle of Inclination.	2nd Gear on Stud.	Gear on Screw.
1.823	28	86	56	100
1.825	36	64	28	86
1.831	36	64	28	86
1.845	34	86	56	120
1.846	36	80	64	156
1.852	64	72	28	120
1.857	25	36	23	86
1.860	28	56	32	86
1.867	28	72	48	100
1.872	56	80	23	86
1.875	24	56	28	64
1.880	86	128	28	100
1.886	24	56	44	100
1.889	34	72	32	80
1.895	..	3°—13′	..	...
1.898	34	86	48	100
1.905	24	56	32	72
1.913	36	64	34	100
1.915	36	80	56	142
1.920	24	40	32	100
1.925	28	64	44	100
1.931	26	36	23	86
1.935	26	86	64	100
1.938	25	36	24	86
1.944	24	48	28	72
1.950	72	80	26	120
1.954	24	40	28	86
1.956	32	72	44	100
1.961	72	80	34	156
1.969	36	64	28	80
1.977	36	72	34	86
1.980	..	3°—10′	..	...
1.983	34	80	56	120
1.990	28	72	44	86
1.996	25	36	23	80
2.000	32	64	40	100
2.005	28	48	44	128
2.008	24	86	72	100
2.015	26	36	24	86
2.022	56	72	26	100
2.026	36	80	64	142
2.030	32	44	24	86
2.035	28	64	40	86
2.040	72	100	34	120
2.045	24	44	24	64
2.047	40	86	44	100
2.057	24	56	48	100
2.063	24	80	44	64
2.067	32	72	40	86
2.070	72	80	23	100
2.074	32	72	56	100
2.080	64	80	26	100
2.084	32	86	56	100
2.090	..	3°— 4′	..	...
2.093	24	64	48	86
2.100	24	32	28	100
2.105	..	3°— 4′	..	...
2.108	34	86	64	120
2.116	56	80	26	86
2.121	24	44	28	72
2.128	34	72	64	142
2.133	32	72	48	100
2.140	64	80	23	86
2.143	24	56	32	64
2.150	86	128	32	100
2.155	72	80	34	142
2.160	72	80	24	100
2.167	26	36	24	80
2.170	28	36	24	86
2.177	72	86	26	100
2.182	24	44	40	100
2.187	36	64	28	72
2.188	24	48	28	64
2.193	24	56	44	86
2.200	32	64	44	100
2.204	34	72	56	120
2.210	34	40	26	100
2.214	34	86	56	100
2.222	24	48	32	72
2.225	..	4°—51′	..	...
2.233	24	40	32	86
2.236	28	36	23	80
2.240	28	40	32	100
2.245	..	3°—50′	..	...
2.250	24	40	24	64
2.254	36	72	64	142
2.261	28	36	25	86
2.267	34	80	64	120
2.270	..	3°—24′	..	...
2.274	32	72	44	86
2.280	..	4°— 9′	..	...
2.286	32	56	40	100
2.292	24	64	44	72
2.295	..	6°—32′	..	...
2.300	..	5°—20′	..	...
2.305	..	3°—40′	..	...
2.310	64	72	26	100
2.315	..	5°—34′	..	...
2.320	..	4°— 7′	..	...
2.326	32	64	40	86
2.330	..	2°—55′	..	...
2.333	24	40	28	72
2.340	36	40	26	100
2.344	28	86	72	100
2.350	..	7°— 5′	..	...
2.357	44	80	24	56
2.361	34	64	32	72
2.365	..	2°—53′	..	...
2.368	28	44	32	86
2.372	72	86	34	120
2.380	34	80	56	100
2.386	24	44	28	64
2.392	24	28	24	86
2.395	..	1°—40′	..	...
2.400	28	56	48	100
2.407	72	80	23	86
2.410	72	56	24	128
2.415	..	3°—18′	..	...
2.419	64	80	26	86
2.424	24	44	32	72
2.431	28	64	40	72
2.435	..	4°—20′	..	...
2.442	24	64	56	86
2.445	40	72	44	100
2.450	28	64	56	100
2.460	..	5°—25′	..	...
2.465	..	4°— 0′	..	...
2.471	34	40	25	80
2.475	..	4°— 0′	..	...
2.481	24	72	64	86
2.485	..	3°—15′	..	...
2.489	28	72	64	100
2.495	..	3°—38′	..	...
2.500	24	32	24	72
2.505	..	4°—17′	..	...
2.512	72	80	24	86
2.514	32	56	44	100
2.520	36	80	56	100
2.526	34	36	23	86
2.530	34	86	64	100
2.537	24	44	40	86
2.540	..	3°—54′	..	...
2.546	28	44	40	100
2.550	72	80	34	120
2.555	32	40	23	72
2.558	24	48	44	86
2.567	28	48	44	100
2.570	34	40	26	86
2.575	..	4°—47′	..	...
2.580	..	3°—12′	..	...
2.584	32	36	25	86
2.590	..	2°—45′	..	...
2.593	28	48	32	72
2.600	..	3°—33′	..	...
2.605	40	86	56	100
2.610	..	3°—53′	..	...
2.616	72	80	25	86
2.619	24	56	44	72
2.658	32	56	40	86
2.667	24	40	32	72
2.670	..	3°— 2′	..	...
2.674	28	64	44	72
2.679	32	86	72	100
2.687	..	..	..	...
2.690	..	3°—29′	..	...
2.700	24	64	72	100
2.705	..	4°—55′	..	...
2.710	..	3°—29′	..	...
2.715	34	36	23	80
2.720	24	80	64	100
2.727	24	44	24	48
2.730	..	3°—48′	..	...
2.736	36	72	56	100
2.740	..	3°—32′	..	...
2.745	34	36	25	86
2.750	40	64	44	100
2.755	..	5°—20′	..	...
2.766	..	4°— 5′	..	...
2.767	34	80	56	86
2.770	..	4°—21′	..	...
2.775	..	2°—40′	..	...
2.778	40	56	28	72
2.785	..	3°—45′	..	...
2.791	32	64	48	86
2.795	..	3°—26′	..	...
2.800	24	48	56	100
2.805	..	4°— 2′	..	...
2.812	24	32	24	64
2.815	..	5°—30′	..	...
2.820	..	4°—19′	..	...
2.825	..	2°—39′	..	...
2.828	28	44	32	72
2.833	34	36	24	80
2.843	40	72	44	86
2.845	32	72	64	100
2.849	28	64	56	86
2.857	24	48	32	56
2.860	..	3°—24′	..	...
2.865	44	86	56	100
2.867	86	72	24	100
2.875	36	40	23	72
2.880	24	40	48	100
2.885	..	3°— 1′	..	...
2.889	32	36	26	80
2.894	32	72	56	86
2.900	..	4°—31′	..	...
2.905	..	3°— 0′	..	...
2.909	32	44	40	100
2.917	24	32	28	72
2.920	..	3°— 0′	..	...
2.924	32	56	44	86
2.930	36	80	56	86
2.934	32	48	44	100
2.940	..	3°—40′	..	...
2.946	24	56	44	64
2.950	28	44	40	86
2.955	..	6°—55′	..	...
2.960	..	6°— 8′	..	...
2.965	..	5°— 9′	..	...
2.970	..	3°—55′	..	...
2.977	40	86	64	100
2.980	..	3°— 0′	..	...
2.984	28	48	44	86
2.990	..	4°—41′	..	...
2.995	..	3°—19′	..	...
3.000	24	40	24	48
3.005	..	6°— 5′	..	...
3.010	..	5°— 7′	..	...
3.015	..	3°—15′	..	...
3.020	34	72	64	100
3.025	..	3°—18′	..	...
3.030	24	44	40	72
3.035	..	4°—25′	..	...
3.040	..	2°—56′	..	...
3.044	24	44	48	86
3.050	..	3°—17′	..	...
3.055	28	44	48	100
3.060	72	80	34	100
3.069	34	40	26	72
3.070	24	40	44	86
3.075	34	36	28	86
3.080	28	40	44	100
3.086	24	56	72	100
3.090	..	4°—50′	..	...
3.095	..	3°—54′	..	...
3.100	32	48	40	86
3.105	..	3°—34′	..	...
3.111	40	72	56	100
3.117	24	44	32	56
3.120	..	3°—15′	..	...
3.125	24	48	40	64
3.126	48	86	56	100
3.135	..	3°—14′	..	...
3.140	24	86	72	64
3.143	40	65	44	100
3.150	28	100	72	64
3.155	..	4°— 5′	..	...
3.160	..	2°—30′	..	...
3.163	34	80	64	86
3.170	..	3°—13′	..	...
3.175	32	56	40	72
3.182	24	44	28	48
3.189	24	28	32	86
3.190	24	86	64	56
3.193	40	64	44	86
3.200	28	100	64	56
3.205	..	4°—18′	..	...
3.210	..	2°—52′	..	...
3.214	24	56	48	64
3.220	..	3°—12′	..	...
3.225	24	100	86	64
3.230	..	4°—44′	..	...
3.235	..	3°—50′	..	...
3.241	28	48	40	72
3.245	..	4°—43′	..	...
3.250	..	3°—29′	..	...
3.256	32	64	56	86
3.260	..	3°—38′	..	...
3.267	28	48	56	100
3.273	24	40	24	44
3.275	44	86	64	100
3.281	24	32	28	64
3.285	..	5°—28′	..	...
3.290	..	4°—28′	..	...
3.295	..	3°—10′	..	...
3.300	44	32	24	100
3.306	34	72	56	80
3.308	32	72	64	86
3.315	..	5°—57′	..	...
3.320	..	5°— 4′	..	...
3.325	..	4°— 0′	..	...
3.330	..	2°— 0′	..	...
3.333	28	48	32	56
3.340	..	3°— 8′	..	...
3.345	28	100	86	72
3.349	48	40	24	86
3.355	..	3°— 8′	..	...
3.360	48	40	28	100
3.365	..	5°—55′	..	...
3.370	..	5°— 2′	..	...
3.375	..	3°—56′	..	...
3.380	..	2°—25′	..	...
3.383	32	44	40	86
3.390	..	5°— 0′	..	...
3.395	..	3°—56′	..	...
3.403	28	64	56	72
3.409	24	44	40	64
3.411	44	72	48	86
3.415	..	3°—40′	..	...
3.422	44	72	56	100
3.428	24	40	32	56
3.429	40	56	48	100
3.435	..	2°—24′	..	...
3.438	24	48	44	64
3.445	..	9°— 0′	..	...
3.450	..	8°—28′	..	...
3.455	..	7°—53′	..	...
3.460	..	7°—16′	..	...

TABLE 2. LEADS FROM 0.249 TO 5.000 INCHES.—*(Concluded)*

Leads.	Gear on Worm.	1st Gear on Stud, and Angle of Inclination.	2nd Gear on Stud.	Gear on Screw.	Leads.	Gear on Worm.	1st Gear on Stud, and Angle of Inclination.	2nd Gear on Stud.	Gear on Screw.	Leads.	Gear on Worm.	1st Gear on Stud, and Angle of Inclination.	2nd Gear on Stud.	Gear on Screw.
3.465	..	6°—35′	..	..	3.979	44	72	56	86	4.495	..	2°—43′	..	..
3.470	..	5°—49′	..	..	3.987	40	56	48	86	4.500	24	32	24	40
3.475	..	4°—57′	..	..	3.990	..	4°— 3′	..	..	4.505	..	4°—58′	..	..
3.480	..	3°—50′	..	..	3.995	..	2°—51′	..	..	4.510	..	4°—11′	..	..
3.488	40	32	24	86	4.000	24	40	48	72	4.515	..	3°—11′	..	..
3.491	48	44	32	100	4.005	..	3°— 8′	..	..	4.522	100	72	28	86
3.492	32	56	44	72	4.011	28	48	44	64	4.525	..	4°—10′	..	..
3.500	24	40	28	48	4.015	..	2°—34′	..	..	4.530	..	3°—11′	..	..
3.505	..	3°—58′	..	..	4.019	72	100	48	86	4.537	56	48	28	72
3.510	..	2°—44′	..	..	4.025	..	4°—57′	..	..	4.540	..	2°—41′	..	..
3.514	34	36	32	86	4.030	..	4°— 2′	..	..	4.545	24	44	40	48
3.520	32	40	44	100	4.035	..	2°—51′	..	..	4.546	32	44	40	64
3.525	..	4°—19′	..	..	4.040	32	44	40	72	4.548	44	72	64	86
3.530	..	3°— 3′	..	..	4.045	..	4°—46′	..	..	4.558	56	40	28	86
3.535	28	44	40	72	4.050	..	3°—49′	..	..	4.567	72	44	24	86
3.540	..	4°—43′	..	..	4.059	32	44	40	72	4.572	32	28	40	100
3.545	..	3°—36′	..	..	4.060	64	44	24	86	4.575	..	3°—10′	..	..
3.552	48	44	28	86	4.065	..	2°—50′	..	..	4.582	72	44	28	100
3.556	40	72	64	100	4.070	28	32	40	86	4.583	44	32	24	72
3.558	36	40	34	86	4.074	32	48	44	72	4.584	28	48	44	56
3.565	28	48	44	72	4.080	..	4°—12′	..	..	4.595	..	8°—54′	..	..
3.571	32	56	40	64	4.085	..	3°— 6′	..	..	4.600	..	8°—30′	..	..
3.572	48	86	64	100	4.091	24	44	48	64	4.605	..	8°— 4′	..	..
3.582	44	40	28	86	4.093	32	40	44	86	4.610	..	7°—37′	..	..
3.585	..	2°—21′	..	..	4.100	..	4°—44′	..	..	4.615	..	7°— 8′	..	..
3.588	72	56	24	86	4.105	..	3°—47′	..	..	4.620	..	6°—37′	..	..
3.595	..	3°— 1′	..	..	4.110	..	2°—32′	..	..	4.625	..	6°— 4′	..	..
3.600	48	32	24	100	4.114	48	28	24	100	4.630	..	5°—27′	..	..
3.605	..	4°—52′	..	..	4.120	..	2°—50′	..	..	4.635	..	4°—45′	..	..
3.610	..	3°—49′	..	..	4.125	24	40	44	64	4.640	..	3°—56′	..	..
3.615	..	2°—20′	..	..	4.130	..	2°—50′	..	..	4.645	..	2°—55′	..	..
3.618	56	72	40	86	4.135	40	72	64	86	4.651	40	24	24	86
3.625	..	4°—28′	..	..	4.140	..	2°—31′	..	..	4.655	64	44	32	100
3.630	..	3°—18′	..	..	4.144	56	44	28	86	4.660	..	3°— 8′	..	..
3.636	24	44	32	48	4.150	..	5°—11′	..	..	4.667	40	48	56	100
3.637	48	44	24	72	4.155	..	4°—21′	..	..	4.670	..	2°—30′	..	..
3.646	40	48	28	64	4.160	..	3°—20′	..	..	4.675	48	44	24	56
3.650	..	3°— 0′	..	..	4.167	28	48	40	56	4.680	..	3°— 8′	..	..
3.655	40	56	44	86	4.170	..	5°— 1′	..	..	4.687	40	32	24	64
3.657	64	56	32	100	4.175	..	4°—10′	..	..	4.688	56	86	72	100
3.663	72	64	28	86	4.180	..	3°— 4′	..	..	4.691	86	44	84	100
3.667	40	48	44	100	4.186	72	64	32	86	4.700	..	4°—25′	..	..
3.673	24	28	24	56	4.190	..	3°—57′	..	..	4.705	..	3°—22′	..	..
3.684	44	86	72	100	4.195	..	2°—48′	..	..	4.710	..	2°—22′	..	..
3.688	86	56	24	100	4.200	72	48	28	100	4.714	44	40	24	56
3.690	..	5°— 0′	..	..	4.205	..	7°—35′	..	..	4.720	32	40	56	100
3.695	..	4°— 0′	..	..	4.210	..	7°— 3′	..	..	4.725	..	3°—55′	..	..
3.700	..	2°—40′	..	..	4.215	..	6°—28′	..	..	4.730	..	2°—53′	..	..
3.704	32	48	40	72	4.220	..	5°—50′	..	..	4.736	64	44	28	86
3.710	..	4°—25′	..	..	4.225	..	5°— 8′	..	..	4.740	..	5°—31′	..	..
3.715	..	3°—16′	..	..	4.230	..	4°—19′	..	..	4.745	..	4°—50′	..	..
3.721	64	56	28	86	4.235	..	3°—18′	..	..	4.750	..	4°— 4′	..	..
3.725	..	3°—45′	..	..	4.242	24	44	56	72	4.755	..	3°— 6′	..	..
3.739	..	2°—18′	..	..	4.245	..	2°—47′	..	..	4.762	40	56	48	72
3.733	28	24	32	100	4.250	36	40	34	72	4.765	..	3°—20′	..	..
3.740	..	4°—11′	..	..	4.253	64	56	32	86	4.770	..	2°— 2′	..	..
3.745	..	2°—58′	..	..	4.264	40	48	44	86	4.773	48	44	28	64
3.750	28	56	48	64	4.267	48	72	64	100	4.778	86	72	40	100
3.755	..	3°—45′	..	..	4.270	..	3°—30′	..	..	4.784	72	56	32	86
3.760	..	2°—16′	..	..	4.275	..	2°—10′	..	..	4.785	48	28	24	86
3.763	86	64	28	100	4.278	28	40	44	72	4.795	..	2°—37′	..	..
3.771	44	56	48	100	4.286	32	56	48	64	4.800	72	48	32	100
3.772	24	28	44	100	4.290	..	3°—55′	..	..	4.805	..	3°—19′	..	..
3.778	34	40	32	72	4.295	..	2°—46′	..	..	4.810	..	2°— 2′	..	..
3.785	..	4°—55′	..	..	4.300	86	56	28	100	4.813	44	40	28	64
3.790	..	3°—56′	..	..	4.305	..	4°—47′	..	..	4.821	72	56	24	64
3.795	..	2°—38′	..	..	4.310	..	3°—54′	..	..	4.825	..	5°—42′	..	..
3.799	56	48	28	86	4.315	..	2°—45′	..	..	4.830	..	5°— 5′	..	..
3.809	24	28	32	72	4.320	72	40	24	100	4.835	..	4°—22′	..	..
3.810	64	56	24	72	4.325	..	4°—55′	..	..	4.840	..	3°—30′	..	..
3.818	24	40	28	44	4.330	..	4°— 5′	..	..	4.845	..	2°—20′	..	..
3.822	86	72	32	100	4.335	..	2°—33′	..	..	4.849	64	44	24	72
3.825	..	4°—32′	..	..	4.341	56	48	32	86	4.855	..	2°—51′	..	..
3.830	..	3°—28′	..	..	4.342	64	48	28	86	4.861	56	64	40	72
3.837	44	64	48	86	4.361	100	64	24	86	4.865	..	5°— 3′	..	..
3.840	64	40	24	100	4.363	24	40	32	44	4.870	..	4°—20′	..	..
3.845	..	2°—55′	..	..	4.364	40	44	48	100	4.875	..	3°—29′	..	..
3.850	28	32	44	100	4.365	40	56	44	72	4.880	..	2°—19′	..	..
3.855	..	5°—58′	..	..	4.370	56	48	24	64	4.884	56	32	24	86
3.860	..	5°—12′	..	..	4.380	..	4°—53′	..	..	4.889	33	40	44	72
3.865	..	4°—19′	..	..	4.386	24	48	44	86	4.898	24	28	32	56
3.870	..	3°—11′	..	..	4.390	..	3°—51′	..	..	4.900	56	32	28	100
3.876	24	72	100	86	4.395	..	2°—45′	..	..	4.905	..	2°—50′	..	..
3.880	..	5°— 2′	..	..	4.400	24	24	44	100	4.911	40	56	44	64
3.885	..	2°—36′	..	..	4.405	..	7°—36′	..	..	4.914	86	56	32	100
3.889	24	24	28	72	4.410	..	7°— 5′	..	..	4.920	..	6°—19′	..	..
3.896	24	44	40	56	4.415	..	6°—33′	..	..	4.925	..	5°—46′	..	..
3.900	..	3°—26′	..	..	4.420	..	5°—57′	..	..	4.930	..	5°—10′	..	..
3.907	56	40	24	86	4.425	..	5°—18′	..	..	4.935	..	4°—28′	..	..
3.911	44	72	64	100	4.430	..	4°—33′	..	..	4.940	..	3°—38′	..	..
3.915	..	2°—15′	..	..	4.435	..	3°—39′	..	..	4.945	..	2°—34′	..	..
3.920	28	40	56	100	4.440	..	2°—27′	..	..	4.950	72	64	44	100
3.927	72	44	24	100	4.444	64	48	24	72	4.955	..	2°—49′	..	..
3.929	24	48	44	56	4.450	..	4°—42′	..	..	4.961	64	72	48	86
3.940	..	7°—20′	..	..	4.455	..	3°—50′	..	..	4.965	..	4°— 9′	..	..
3.945	..	7°—16′	..	..	4.460	..	2°—43′	..	..	4.970	..	3°—38′	..	..
3.950	..	6°—11′	..	..	4.465	64	40	24	86	4.975	..	2°— 0′	..	..
3.955	..	6°— 2′	..	..	4.466	56	64	44	86	4.978	56	72	64	100
3.960	..	5°—18′	..	..	4.477	56	64	44	86	4.984	100	56	24	86
3.965	..	4°—27′	..	..	4.479	86	64	24	72	4.990	..	3°—38′	..	..
3.970	..	3°—24′	..	..	4.480	64	40	28	100	4.995	..	2°—34′	..	..
3.977	28	44	40	64	4.490	..	3°—50′	..	..	5.000	48	32	24	72

the cam enabling one to see the layout on the cam, as well as being more rigid. By turning the index crank the blank is fed against the cutter. When receding, we turn the handle of the milling machine table and the blank will move away from the cutter before it starts to turn, due to the back lash in the gears, thus preventing the cutter from dragging over the work while backing off. To set the cam for new cut after backing off, pull pin in crank out of index plate and turn handle of machine the required amount; then insert crank pin.

The minimum length of mill that can be used = lead of machine × sine angle of inclination, + thickness of blank. This may be one possible objection to this method for leads of any length, because, as the angle of inclination approaches 90 degrees as a limit, the length of mill required will equal the lead of the machine.

Figs. 3 and 4 are cams designed to be used on a No. 00 Brown & Sharpe automatic screw machine to make the flat-head screw shown in Fig. 5. The cam in Fig. 4 has only one lead, the rest of the contour being milled to the line.

In case it was desired to put on the leads with the head and spindle set vertical, changing the gears for each rise, we find by referring to the table that the gears are given for the two greater leads (0.585 and 0.580 inch), but the inclination method is given for 0.200 inch. However, 0.200 inch can be raised to a greater lead by multiplication, and gears selected for this, without inclining the head; and then, by the use of an extra pair of gears and stud, the lead can be reduced as follows: $0.200 \times 3 = 0.600$. Now looking in the table for gears giving lead of 0.600 inch, we find;

$$\frac{24 \times 24}{80 \times 120}$$

Since this combination will give a rise three times greater than required, we must introduce two more gears with a ratio of three to one. Say we use gears 24 and 72; then we have the combination:

$$\frac{24 \times 24 \times 24}{80 \times 120 \times 72}$$

which will give the required lead of 0.200 inch. The positions of the first four gears are as shown in the table, and the 24 to 72, or any 3 to 1 set, are put on the second stud or compound arm, so as to give the proper reduction. In like manner, any lead given in the table, using the angle method, can be treated as above, if we wish to use six or more gears.

The gears of any combination may be transposed; that is, the two driving gears, the two driven gears, or both. But not a driver for a driven, or *vice versa*. This is important and should be thoroughly understood in order that the table may be used to the best advantage. Combinations of gears that are too small in diameter to reach for right-hand spirals, can be used by means of single or double reverse gears, depending upon whether the spiral is right or left hand.

By referring to Fig. 2 we can see that for a given movement, *A*, of the milling machine table, there is a corresponding rise, *B*, cut on cam, and a movement, *C*, of the cam of the cutter.

Accompanying table of gears for leads from 0.075 inch to 5.000 inches has been very carefully worked out, so as to give the greatest number of leads possible, using four gears for each setting, with as limited a number of gears for each machine as is considered practical. The angle of inclination is given wherever a suitable combination could not be worked out for a desired lead, and the gears that are to be used with the given angle will be the first set following for the larger leads.

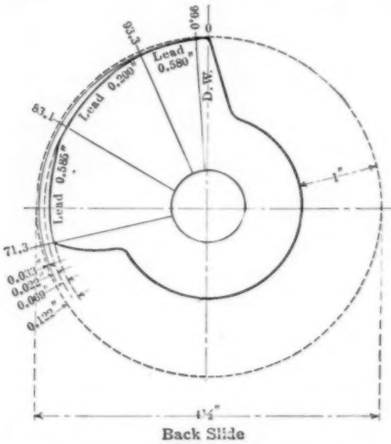


FIG. 3

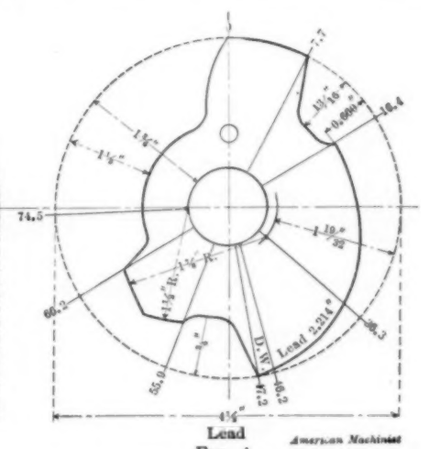
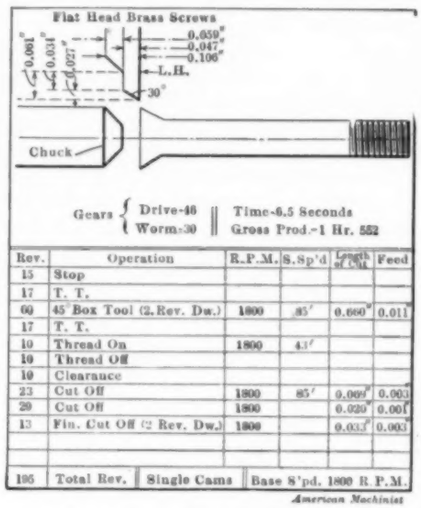


FIG. 4

CAMS FOR NO. 00 BROWN & SHARPE AUTOMATIC SCREW MACHINE USED AS EXAMPLES



Rev.	Operation	R.P.M.	S.Sp'd	Length of Cut	Feed
15	Stop				
17	T. T.				
60	45° Box Tool (2 Rev. Dw.)	1800	.85'	0.660"	0.011"
17	T. T.				
10	Thread On	1800	4.1'		
10	Thread Off				
10	Clearance				
23	Cut Off	1800	.85'	0.009"	0.003"
20	Cut Off	1800		0.020"	0.001"
13	Fin. Cut Off (2 Rev. Dw.)	1800		0.033"	0.003"
195	Total Rev.	Single Cams	Base S'pd. 1800 R.P.M.		

American Machinist

FIG. 5. OPERATIONS FOR WHICH CAMS WERE CUT

Obtaining Patent Specifications

BY H. L. SMITH

In order to place the publications of the Patent Office within easy reach of inventors and others interested in them, it is suggested that the coupons now sold by this department at Washington, might be placed on sale at the money-order windows of all post offices. For use when only one publication is sent for at a time, this coupon might be printed on a postal card which could be mailed for one cent.

At first glance this appears to be a pretty small thing to make much talk about, but just consider it for a moment. Look at the proposition from the standpoint of the individual inventor who is not located within easy reach of his attorney (if he has one), or the Patent Office. A patent is issued which this inventor is anxious to see and study, so he must procure a copy of it. He can write to his attorney, asking him to send to Washington for a copy, or he can order it direct from the Commissioner of Patents himself. This sounds simple enough, does it not? The first method means delay and some bother to the attorney. The trouble with the second method lies in getting the five cents to the commissioner. The Patent Office will not accept postage stamps in payment; personal checks are not accepted; coin may be mailed at sender's risk; registering the letter adds eight cents and sending a money order adds three cents to the cost of the document wanted. This is a good deal to the majority of inventors, especially while they are inventing.

This extra expense can be minimized by purchasing a book of one hundred or a pad of twenty of these coupons at once, but this is not always convenient. The adoption of the above suggestion would, therefore, be a great benefit and convenience to many of us.

Expense Accounts and Analysis

By Holden A. Evans*

Outline of expense schedules and a form of comparative monthly analysis.

*Naval constructor, United States Navy.

Each shop will be designated by a letter, as B for the boat shop, M for the machine shop, S for the smith shop, P for the pattern shop, etc. As S is the symbol for shop expense, the shop-expense designations will then be SB for the boat shop, SM for the machine shop, SS for the smith shop, SP for the pattern shop, etc. The subdivisions under each of the general heads will be designated by additional letters, as SMA, supervisory force of machine shop, SMD, dressing and grinding machine-shop tools, etc. The subdivisions in all shops are very similar, and to save space, those of but one shop, the machine shop, will be given. The symbols used for a subdivision should be the same in all shops; for example, D is the symbol selected for dressing and grinding tools, and SMD is the charge symbol for dressing and grinding machine-shop tools, then SSD should be the charge symbol for dressing and grinding smith-shop tools, and SPD for the pattern shop, etc. This system of charge symbols is from information obtained from Fred W. Taylor, and his former assistants, but I have not been able, for reasons which have no bearing on the merit of the system, to follow Mr. Taylor's excellent methods in all details.

SM Shop expense machine shop:

SMA Supervisory and office force. Includes wages paid to foremen, assistant foremen, and all men acting in a supervisory capacity. Includes the pay of planners, clerks, messengers and others employed in the shop office.

SMB Miscellaneous labor: Wages which it is impracticable to charge to production orders, such as shop cleaners, crane operators, move men, general floor helpers, etc., but does not include any labor that can be charged to other SM orders.

SMC Fixtures and furniture: Labor and material for repair and maintenance of fixtures and furniture, both fixed and movable, such as benches, shelving, desks, stools, clocks, bells, trays, tote boxes, hand carts, etc. Any changes or additions will only be made on order from the office. Repairs estimated to exceed $50 will be made on special orders and charged to this account. These orders will not carry indirect charges.

SMD Dressing and grinding old tools: Includes the dressing and grinding of old tools only and the transportation to and from the shop. The dressing and grinding of new tools is not included in this order, this work being charged to the order for the manufacture of the tools. Charges are to be made against the shop using the tools and not against the shop doing the work.

SME Maintenance of small and loose tool equipment: Repair of large loose tools, such as vises, hydraulic jacks, pulley blocks, anvils, etc. Repairs to pneumatic tools and pneumatic hoists are not to be charged to this order. Includes repair (not dressing and grinding) of small tools; includes the purchase or manufacture of such tools, as drills, chisels, files, milling cutters, taps, dies, planer, lathe and shaper tools, etc., when such tools merely maintain and do not increase the tool-room stock. Tools that increase the stock will be supplied on written orders from the main office and charged to XM orders. Charges must be made to the shop that is to use the tools and not to the shop that does the work.

SMG Special tools: Repairs and maintenance of jigs, dies, gages, templets, etc. Only covers repairs and replacements and not additions. Charges are to be made to the shop which is to use the tools and not against the shop that does the work. Repairs estimated to exceed $100 will be made on special orders and charged to this account. These orders will not carry indirect charges.

SMH Pneumatic tools and hose. Repair and maintenance of the pneumatic tools for the machine shop and machine-shop force working outside of the shop, such as drills, hammers and air motors for driving boring bars. Includes cost of air hose for machine shop. Does not include pneumatic hoists, which are chargeable to SMK.

SMI Belting: Repairs and maintenance of belting. Includes new belting for replacing old, belt lacing, glue, tools, etc. Charges for new belting with new equipment are to be made to specific orders.

SMJ Power transmission: Includes labor and material for the maintenance, repair and operation of line shafting, countershafting, piping and wiring inside of shops for the transmission of power. Includes motors not forming a part of a machine tool, includes electric

MANUFACTURING DEPARTMENT. SHOP EXPENSE REPORT.
MACHINE SHOP—"SM"

Account.	Symbol.	July. Labor.	July. Material.	August. Labor.	August. Material.
Supervisory and office force	SMA				
Miscellaneous labor	SMB				
Fixtures and furniture	SMC				
Dressing and grinding old tools	SMD				
Maintenance of small- and loose-tool equipment	SME				
Fixed charges	SMF				
Special tools	SMG				
Pneumatic tools and hose	SMH				
Belting	SMI				
Power transmission	SMJ				
Cranes, hoists and elevators	SMK				
	SML				
Repairs to machine tools	SMM				
	SMN				
	SMO				
Power, heat and light	SMP				
Correction of errors	SMR				
General stores and supplies	SMS				
Operation of tool room	SMT				
Part plant development	SMX				
Repairs and maintenance of buildings	SMZ				

FIG. 1. FORM FOR SHOP EXPENSE REPORT.

controllers not forming a part of a machine tool. Does not include belting. Does not include repairs to light wiring nor radiators. Repairs estimated to exceed $100 will be made on special orders and charged to this account. These orders will not carry indirect charges.

SMK Cranes, hoists and elevators: Includes labor and material for repair and maintenance of cranes, hoists and elevators. Includes pneumatic hoists. Does not include cost of operation. Repairs estimated to exceed $100 will be made on special orders and charged to this account. These orders will not carry indirect charges.

SML ————————

SMM Repairs to machine tools: Includes labor and material for repairs to machine tools. Where motors are direct connected and form a part of the machine, repairs to motors and controllers will be charged to this order. Repairs estimated to exceed $100 will be made on special orders and charged to this account. These orders will not carry indirect charges.

SMN ————————

SMO ————————

SMP Power, heat and light: Monthly cost of proportionate share of power, heat and light. No charges will be made direct to this order. At the end of each month the cost of machine-shop power will be transferred from the power account to this account.

SMR Correction of errors: Labor and material required to correct errors made by the machine shop. All errors must be reported and the correction charged to this number. Correction of errors estimated to cost in excess of $50 will be done on special orders and charged to this account. These orders will carry no indirect charges.

SMS General stores and supplies: Includes miscellaneous material, such as waste, oil, brooms, etc., for the use of the shop. Also material used on output which on account of its character and the small quantities used on each job cannot be charged direct.

MANUFACTURING DEPARTMENT. GENERAL EXPENSE REPORT.

—"G"—

Account.	Symbol.	July.		August.	
		Labor.	Material.	Labor.	Material.
Salaries of general officers	GA				
Office salaries	GB				
Cleaning and care of yard, outside of shops	CC				
Drawing office	GD				
Experiments	GE				
Fixed charges	GF				
Repairs and maintenance of floating property	GG				
Hauling, handling stores and shipping	GH				
Stable expense	GI				
Legal expense	GJ				
Dues and assessments	GK				
Leave and holidays	GL				
Patents	GM				
Telephone and telegraph	GN				
General office fixtures and furniture	GO				
Plant repairs outside shops	GP				
Office supplies and postage	GS				
Traveling expenses	GT				
	GU				
Miscellaneous	GV				
Watchmen	GW				
Part plant development	GX				
	GY				
Repairs and maintenance of buildings	GZ				

FIG. 2. FORM FOR GENERAL EXPENSE REPORT.

SMT Operations of tool room: Includes wages of men working in the tool issue room, also the tool boys. Does not include labor of toolmakers, which should be charged to work on which engaged.

SMX Part plant development: Monthly charges for one-half the part plant development charges for the benefit of the machine shop. No charges are made direct to this order. At the end of each month one-half of the charges against XM orders are transferred to this account.

SMZ Repairs and maintenance of buildings: Includes labor and material expended in the repair and maintenance of machine-shop buildings, crane runways, foundations for machine shops, inside drains and sewers, lavatories in shop, plumbing, radiators in shop, light wiring in shop, globes, lamps and carbons. Repairs estimated to exceed $100 will be done on special orders and charged to this account. These orders will carry no indirect charges.

SMF Machine-shop fixed charges: As given in subheads which follow:

SMFD Depreciation of machine-shop buildings, machinery, equipment and tools.

SMFF Fire and accident insurance on machine-shop buildings and equipment.

SMFI Interest on money invested in machine shop, land, buildings and equipment.

SMFN Indemnity insurance for machine-shop force.

SMFT Taxes on machine shop, land, buildings and equipment.

P—POWER, HEAT AND LIGHT

PA Power-house labor: All labor connected with the operations of boilers, engines, generators, air compressors and other power machinery. Includes salary of engineer in charge. Does not include labor or repairs except when repairs are made by the regular power-house attendants. Does not include repairs and attendance of wiring and piping outside of power station for the transmission of power.

PB Repairs to boilers: Labor and material for repairs to boilers, uptakes, stacks, boiler fittings, injectors, feed pumps, water heaters, coal- and ash-handling apparatus, or oil pumps and burners. Repairs estimated to exceed $100 will be made on special orders and charged to this account. These orders will not carry indirect charges.

PC Repairs to air compressors: Labor and material for repairs to compressors, intercoolers and outercoolers. Repairs estimated to exceed $100 will be made on special orders and charged to this account. These orders will not carry indirect charges.

PD Distributing system, electric: Labor and material for repairs and attendance on electrical distributing system outside of power plants and outside of shops. Includes wiring, poles, static transformers, conduits and lamps outside of shops. Repairs estimated to cost in excess of $100 will be made on special orders and charged to this account. These orders will not carry indirect charges.

PE Repairs to electric generators, switchboard and wiring inside of power station: Labor and material for repairs to electric generators and engines driving same, switchboard, and wiring inside of power house. Repairs estimated to cost in excess of $100 will be made on special orders and charged to this ac-

count. These orders will not carry indirect charges.

PF Power-house fuel: Cost of fuel, including labor for handling same. Cost of removing ashes.

PG Distributing system, steam: Labor and material for repairs and attendance for the steam-distributing system, including heating lines, from power house to shops. Repairs estimated to exceed $100 will be made on special orders and charged to this account. These orders will carry no indirect charges.

PH Repairs to hydraulic machinery: Labor and material for repairs to hydraulic pumps and motors driving same, and accumulators. Repairs costing in excess of $100 will be made on special orders and charged to this account. These orders will not carry indirect charges.

PI Distributing system, hydraulic: Labor and material for repairs and attendance for the hydraulic distributing system from power house to shops. Includes accumulators outside of power plant. Repairs estimated to cost in excess of $100 will be made on special orders and charged to this account. These orders will not carry indirect charges.

PM Repairs to miscellaneous machinery: Labor and material for repairs to miscellaneous machinery not included under other numbers, such as condensers, air pumps, cranes, motors, transformers and other auxiliary machinery. Repairs estimated to cost in excess of $100 will be made on special orders and charged to this account. These orders will carry no indirect charges.

PN Distributing system, pneumatic: Labor and material for repairs and attendance on pneumatic distributing system from the power house to the shops. Includes supply of hose and portable pipe lines run for the benefit of several shops or a number of different jobs. Includes cost of inspectors for waste of air and abuse of air tools. Repairs estimated to cost in excess of $100 will be made on special orders and charged to this account. These orders will carry no indirect charges.

PO Lubricating oil: Cost of lubricating oil for power plant, including cost of handling.

PP Repairs to piping: Labor and material for repairs to all piping inside of power plant. Repairs estimated to cost in excess of $100 will be made on special orders and charged to this account. These orders will carry no indirect charges.

PQ Repairs to water system: Labor and material for repairs to water systems from power house and outside of shops. Does not include cost of water purchased, which is charged to PS. Repairs estimated to exceed $100 will be made on special orders and charged to this account. These orders will carry no indirect charges.

PR Fixtures, furniture and tools: Labor and material for repair and maintenance of fixtures, furniture and tools in power house, such as desks, chairs, lockers, shovels, scrapers, flue cleaners, wrenches, jacks, etc.

PS Stores and supplies: All stores and supplies for power plant except fuel and lubricating oils. Includes waste, packing, stationery, water, brooms, brushes, soap, boiler compounds, etc.

PT Interest: Monthly charge for interest on money invested in land, buildings, machinery, tools and equipment of power house and power lines.

PU Depreciation: Monthly charge for depreciation of buildings, tools and equipment of power house and power lines.

PV Taxes: Monthly charge for taxes on land, buildings, tools and equipment of power house and power lines.

PW Insurance: Monthly charge for insurance of power plant and equipment.

PY Electric current purchased: Cost of electric current purchased from outside plants.

PZ Repairs and maintenance of power house buildings: Includes labor and material expended in the repair and maintenance of power-house buildings, crane runways, foundations for boilers, engines and other machinery, inside drains and sewers, lavatories, plumbing, radiators, light, wiring, lamps and carbons. Repairs estimated to cost in excess of $100 will be made on special orders and charged to this account. These orders will carry no indirect charges.

MANUFACTURING DEPARTMENT. SUMMARY OF EXPENSE ACCOUNTS.

Account.	Symbol.	This Month. Labor. Direct	This Month. Labor. Indirect. Amount.	This Month. Labor. Indirect. Per Cent.	This Month. Material. Indirect. Amount.	This Month. Material. Indirect. Per Cent.	Last Month. Labor. Indirect. Amount.	Last Month. Labor. Indirect. Per Cent.	Last Month. Material. Indirect. Amount.	Last Month. Material. Indirect. Per Cent.	Average This Year to Date. Labor. Indirect. Amount.	Average This Year to Date. Labor. Indirect. Per Cent.	Average This Year to Date. Material. Indirect. Amount.	Average This Year to Date. Material. Indirect. Per Cent.
General	G													
Sheet metal shop	SA													
Boat shop	SB													
Coppersmith	SC													
Foundry	SD													
Electric shop	SE													
Shipwright	SF													
Joiner	SJ													
Shipfitter	SK													
Laborer	SL													
Machine shop	SM													
Boiler shop	SN													
Pattern shop	SP													
Smith shop	SS													
Shipwright	ST													
Painter	SW													

FIG. 3. SUMMARY OF EXPENSE ACCOUNTS.

A summary of the factory expense is given in a monthly report. This shows the total expenditures under each shop expense and under general expense for this month, last month, and the average of the year to date. It also shows the charges for direct labor on output in each shop and the percentage of each expense to direct labor. A convenient form for this report is given above.

Distribution of Power Expense

The total of all P charges—power-house expense—is each month distributed to the various shops and the storehouse, in accordance with the estimated amount of power that has been used by each. No distribution is made to "general expense," though a small part has been used for heating and lighting the main offices. The amounts so distributed are taken up in the proper account under shop expense or storehouse expense.

H—Storehouse Expense

HA Salaries of officers of storehouse and purchasing department.

HB Salaries of clerks, stenographers, messengers and janitors.

HC Salaries of storehouse labor not included in HA and HB.

HD Handling stores: Labor and material for handling stores to and from storehouse, not including regular store men. Includes drivers for teams and operators of locomotive cranes when handling stores. Special orders will be issued for handling quantities of heavy or bulky material and the cost located direct to the cost of the material.

HE Inspecting and testing: Labor and material for testing and inspecting material delivered. Includes cost of chemical analyses and physical tests.

HF Repairs to fixtures and furniture: Labor and material for maintenance of office and storehouse furniture and fixtures, including shelving, bells, clocks, elevators, speaking tubes, tools, typewriters, comptometers, etc. Repairs estimated to exceed $50 will be made on special orders and charged to this account. These orders do not carry any indirect charges.

HI Insurance: Monthly charge for insurance of storehouse buildings and stock.

HJ Depreciation of buildings: Monthly charge for depreciation of storehouse buildings. Does not include waste and depreciation of stock.

HK Depreciation and waste of stock: Monthly charge for depreciation and waste of storehouse stock.

HL Interest: Monthly charge for interest on money invested in storehouse buildings and stock.

HM Freight and express: Expenses for incoming freight and express when it is not practicable to locate this direct to the material. When practicable the freight or express will be added to the purchase price of the material:

HP Power, light and heat: Proportionate share of power-house expense. No charges are to be made to this order but at the end of each month the amount charged will be transferred to this account from the power account.

HS Office supplies and expenses: Includes all office and storehouse supplies, including stationery, books, brooms, etc. Includes expense of telegrams, postage and telephones for the benefit of the storehouse.

HT Taxes: Monthly charge for taxes due to storehouse land, buildings and stock.

HZ Repairs and maintenance of storehouse buildings: Includes labor and material expended in the repair and maintenance of storehouse buildings, lavatories, plumbing, wiring and lights, drains and sewers inside of buildings. Repairs estimated to exceed $100 will be made on special orders and charged to this account. Those orders will not carry any indirect charges.

Distribution of Storehouse Expense

No indirect charges will be made to any storehouse orders, as these are in themselves indirect charges. The storehouse expense will be distributed on the basis of the value of stores issued to the manufacturing department. In the cost department, at the end of each month, a percentage will be added to the total cost of material drawn from store during the month for each order. This percentage is based on previous experience. A loss and gain account will be kept, showing each month the total expense charged to job orders and the actual expense, and the percentages used will be corrected from time to time so as to keep this account approximately balanced.

The depreciation of the storehouse buildings will be carried to the regular depreciation account. The depreciation and waste of stock will be taken up in a separate account which will be credited with losses in stock, shown by inventory, and the account at the end of the year will be closed into profit and loss.

X—Part Plant Development

Includes the cost of articles manufactured or purchased which, while they add to the equipment and increase the plant valuation, are of such a nature that their life is short. These are small and loose tools, pneumatic tools, fixtures and furniture, which are not replacements but add to the stock, also new patterns, which cannot be charged to production orders. One-half of the charges under this account are carried each month to the proper shop expense or to general expense, and the remainder is taken up under special capital accounts which are eliminated in two years by depreciation charges. No charges will be made to part plant development accounts except on specific written order from the manager. There should be no standing job orders under this account, for if used, work which is in reality expense account work will probably be charged to these orders.

Job orders for work under this account are numbered with numerals followed with designating letters showing the shop or general expense account. For example, the order for additional small tools for the machine shop will be numbered 125XM; and the order for additional forges for the smith shop will be numbered 126XS.

The part of the account which is taken up under the capital account is considered as "output" of the factory and as such carries its proportion of the indirect charges, while the part transferred to the expense accounts, being itself an expense, does not carry indirect charges. In other words, one-half of the X charges carry indirect charges and one-half do not.

E—Selling Expense

Includes all expenses incurred in selling the product, such as salaries, advertising, postage, traveling expenses, discounts, etc. Includes proportion of fixed charges for office building. Includes charges for services of estimating department and drawing office when for the benefit of sales. Details of the charges are given under the subheads:

EA Salaries of officers of sales department.

EB Salaries of salesmen.

EC Salaries of clerks, stenographers, messengers and janitors.

ED Discounts.

EE Estimates: Expenses due to the preparation of plans and estimates for the benefit of sales.

EF Repairs to fixtures and furniture of sales department.

EG Advertising.

ES Office supplies and expenses: Sales-department office supplies, including postage, telegrams and telephones.

ET Traveling expenses for the benefit of sales.

EU Fixed charges: Includes a monthly charge for rent of office room which includes depreciation, interest, taxes and insurance.

EV Miscellaneous: Includes expenses not otherwise classified. Such as entertaining, etc.

Distribution of Selling Expense

This has been fully discussed in a previous article. See page .

Plant Development

Work done for plant development should be treated as if the work were for a customer. Output job orders should be issued and the cost should include indirect costs. The total cost of each job or undertaking should be taken up under appropriate sub-accounts of the capital account. Care should be exercised that no work which does not give a real increase in the value of the plant is considered as plant development.

Supervision of Expense Accounts

There should be prepared each month for the manager a summary of the expenditures under each expense account. These should be so arranged that a comparison can be made with past perform-

ances. This can be done by means of curves or by parallel columns as shown below. By means of these data the manager has information which will enable him to check extravagance.

SHOP EXPENSE REPORT

For each shop there should be a report which gives in parallel columns the expenditures by months under each subhead of the shop expense accounts. A convenient form is given.

GENERAL EXPENSE REPORT

The general expenses are summarized each month on a form which shows the expenditures under the sub-heads in parallel columns for each month of the year, as follows: See Fig. 2.

A similar comparative report is made each month for power-house expense, selling expense, and the drawing-office expense.

Friction Clutch for Machine Tools

By Robert Reid*

A pneumatically operated friction clutch successfully applied to large planers and slotters in the General Electric plant.

Self contained, with quick return gearing, driven from constant speed, non-reversing electric motor.

Compressed air acts upon conical shells with wood friction blocks.

No end thrust on any bearings.

*Mechanical superintendent's department, General Electric Company.

Friction clutches of various designs have been used by machine-tool builders for a considerable length of time and with varying degrees of success. These have shown a great deal of ingenuity in design and, in some cases, have possessed great merit; but there are comparatively few that are able to meet the requirements of the modern machine tool where, by the use of high-speed steel and heavy cuts and feeds, the duty placed upon it calls for an efficiency in the clutch far in excess of anything that has been called for in the past.

The friction clutch as applied to machine tools must be of such size and strength as will enable it to transmit the required power, strong enough to resist all shocks, and yet not too heavy. It must, however, have enough metal so distributed as will enable it to radiate and dispel rapidly the heat that may be generated, due to the rubbing and slipping of any of its parts. It must be capable of gripping, or taking hold slowly or quickly, without unnecessary shock, as conditions may require, and also releasing in the same positive manner. In short, it must be absolutely reliable at all times; for if it is at all uncertain in its actions it would be dangerous to use, especially on reciprocating machine tools where, if the reversal of the tool or table carrying the work did not take place at the proper time, it might cause the spoiling of the work, or perhaps the total breakdown of the machine in question, with the added danger to the operator. It can readily be seen, therefore, why so few friction clutches have been adopted for the driving of machine tools of the reciprocating type, such as planers and slotters.

The clutch shown in the accompanying illustrations is the invention of John Riddell, mechanical superintendent of the General Electric Company at Schenectady, N. Y. This clutch has filled all the requirements to such an extent that nearly all of the large stationary and portable slotting machines, and also the larger sizes of planers in the Schenectady plant have been equipped with it, and are giving satisfaction. The clutch was brought out at a time when individual motor drives were being applied to machine tools, and when the employment of compressed air for many useful purposes was rapidly coming to the front, and the ease and effectiveness with which it could be handled were good reasons for giving it a trial in friction clutches.

By reference to the sectional view shown, the construction can very readily be seen. It is double acting and has two conical cast-iron clutch shells *A*, bushed to fit the shaft *B* upon which they turn. Suitable gears are mounted and keyed upon the hubs of these clutch shells, as may be seen in Figs. 1 and 2. Upon the same shaft, and between the clutch shells, is placed the air cylinder *C*. This cylinder is made in two parts bolted together at the center by means of the flanges. They are also provided with stuffing boxes and sliding glands to prevent air leakage along the shaft. The construction of this gland is such that when the air pressure is applied it presses against the end of the gland, expanding the packing and thus preventing air leakage along the shaft and when the air has been discharged the gland is free to move slightly, avoiding any friction at this point. As the cylinder and shaft rotate together there is no wear on the packing except a very small amount, due to the end movement of the cylinder. The cylinder is so designed that the ends fit into the clutch shells and these ends are also milled out to receive the wood friction blocks *D*. These blocks are all made of a uniform size, and are secured in place by means of the screw shown, except in the latest clutch made, where a special clamping arrangement is being tried out and which may eventually supersede the screw through the block.

Piston *E* is fixed to the shaft by a shrink fit and thus rotates with it at all times. A lock pin *F*, tight in the piston, extends outward from each side of the piston and fits loosely in a corresponding pocket in each end of the cylinder. It is through this pin that motion is transmitted from the cylinder, through the piston, to the central shaft *B*. The piston rings are of the ordinary cast-iron type, split and sprung into place.

Compressed air for the operation of the clutch is admitted through one end of the shaft, which is hollow, and also through a special stationary end swivel, to which the necessary air piping is con-

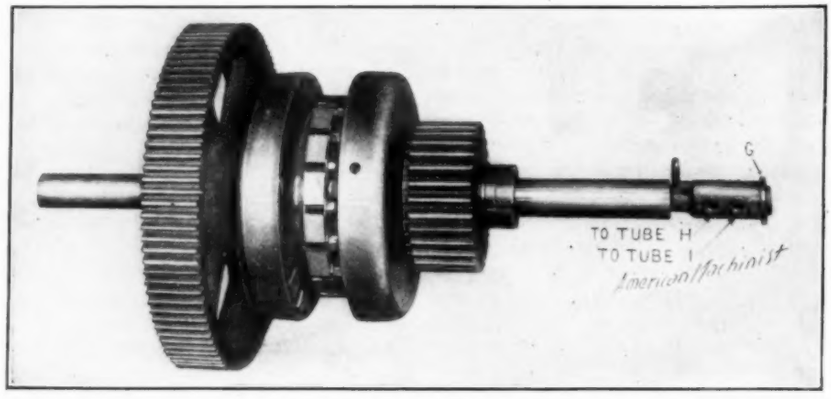


FIG. 1. PNEUMATIC CLUTCH FOR 84-INCH PLANER. ALL PARTS ASSEMBLED

nected. It will be seen that the bore of the shaft is of three different diameters; air passing into one end of the cylinder through the air swivel *G*, Fig. 1, and the tube *H*, Fig. 3, which is pressed tightly into the small bore of the shaft; and through the tube *I*, Fig. 3, into the other end of the cylinder. The outer ends of the tubes are closed to prevent any leakage of air at this point. The tube *I* extends beyond the end of the shaft, and on this extension is placed the air swivel which is so constructed as to permit a free rotation of the tube, and also packed against air leakage from one side

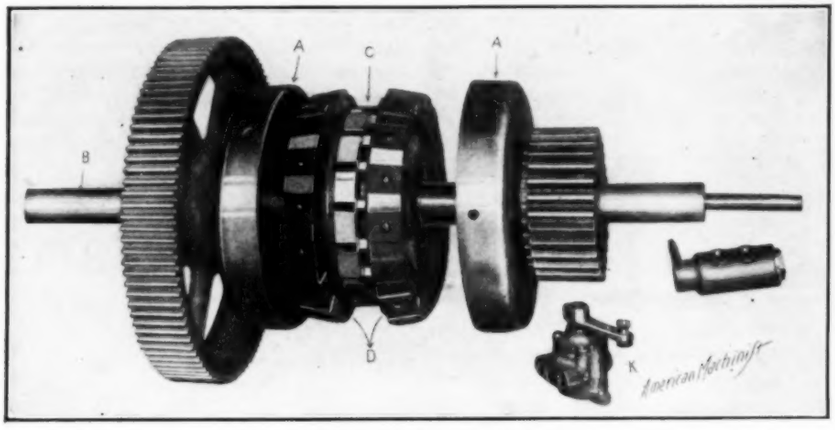


FIG. 2. PARTS OF CLUTCH SEPARATED

to the other. A small angle bracket, or brace is placed against the end of the swivel to prevent its being blown off by the air pressure; the necessary piping preventing it from turning with the shaft.

Controlling valve *K*, Fig. 2, is very simple, although somewhat special. It is cylindrical in form, with two inlet ports and one discharge, as in the ordinary steam engine where the D-shaped slide valve is used; but, where the steam in the engine is on the outside of the valve, in this valve the compressed air is admitted to the inside of the valve, which, being split on the top and somewhat thinner at this point, has the tendency to expand and keep the valve tight and prevent any leakage. This valve is so placed as to permit its operation by any reciprocating part of the machine, such as the table of the planer, or the ram of the slotter.

In practice it has been found that the ordinary air pressure is too high, and that the best results have been obtained with pressure ranging from 15 to 20 pounds per square inch, the pressure being regulated by means of a reducing valve so as to give an easy movement to the clutch, but yet powerful enough to hold it in place during the operation. The pressure must not be too high, for if it is it produces a shock, which should be avoided and which can be regulated very nicely with this valve. The ordinary shop pressure being about 85 to 90 pounds per square inch and the clutch requiring only about 15 to 30 pounds per square inch, it can readily be seen that there is a very wide margin of reserve power for moving and holding the clutch surfaces in contact. When the wood blocks *D* have been worn away to such an extent that the clyinder comes up against the piston, thereby preventing the blocks from taking hold of the clutch shells, it is necessary only to stop the machine and by means of a screwdriver loosen up the screw that holds the block in place and insert one or more liners of sheet iron under each block; tighten up the screws and go ahead. Due to the very slight wear of these blocks they have gone in some cases very nearly a year before requiring any adjustment.

In use on a planer or slotter the usual method is for the motor pinion to mesh with a gear on an intermediate shaft, this gear also being in mesh with the gear on one of the clutch shells. On the other end of the intermediate shaft is a second pinion which drives the other clutch shell in the opposite direction by means of an idler gear not shown. The motor running at a constant speed, thus drives the clutch shells at the required cut and return speeds. The clutch shells, due to their size and weight, possess a certain flywheel effect that is of considerable assistance in starting the platen or ram of the machine from a state of rest. By reason of the angle of the clutch shells, which is about 15 degrees, the movement of the cylinder and friction blocks is very slight.

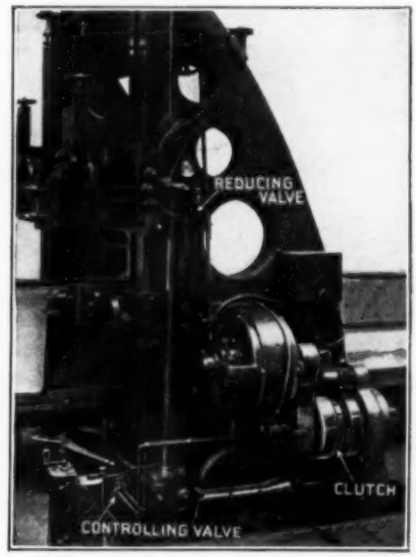


FIG. 4. APPLICATION OF PNEUMATIC CLUTCH TO 120-INCH PLANER

Another feature of the design is that the entire end thrust due to the air pressure is all self-contained. This thrust in the older clutches is taken up by means of the lock nuts shown in the sectional view; while in the later type, one set of these nuts has been

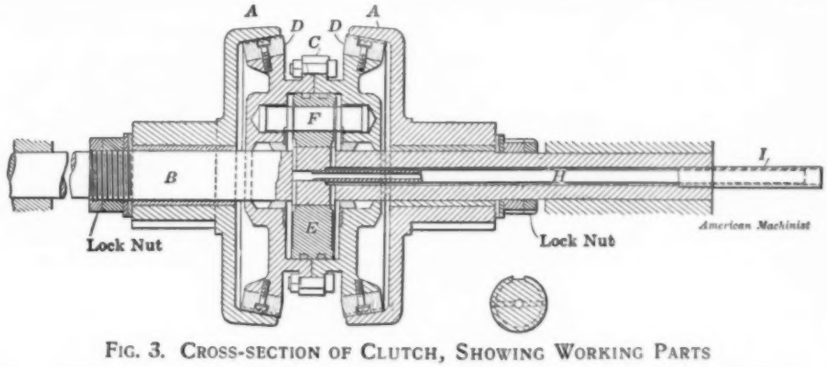


FIG. 3. CROSS-SECTION OF CLUTCH, SHOWING WORKING PARTS

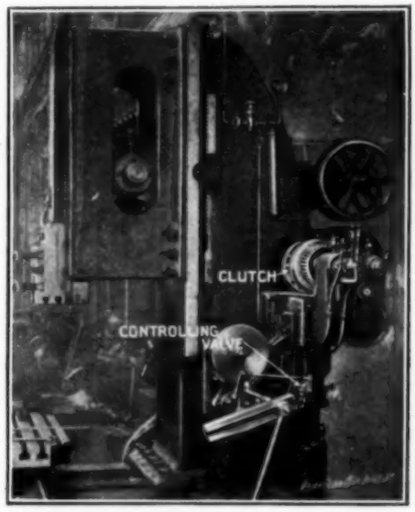


FIG. 5. PNEUMATIC CLUTCH APPLIED TO 68-INCH NILES SLOTTER

superseded by means of a shoulder on the shaft. It is thus able to rotate freely without any end pressure against the bearings. Fig. 2 shows the clutch mounted loosely upon the shaft, with end-thrust lock nuts removed. Fig. 1 shows all in place ready for placing in bearings. Fig. 4 shows its application to a 120-inch planer, that is driven by a 25-horsepower General Electric motor. This clutch is known as a 24-inch clutch. The table speeds are about 25 feet cut and 75 feet return; the air pressure about 15 pounds per square inch.

It has been found that a planer of this size on which the platen and work will frequently weigh about 40 to 50 tons, can, if necessary, be operated on a 10- or 12-inch stroke for a short time; whereas, with the old belt drive it required about 3 feet in which to reverse the platen. In one case observed the cut was about 12 to 15 inches in length, and the total travel of platen about 36 inches. Fig. 4 shows very clearly the manner of setting up the entire motor drive, with the air swivel, controlling valve and lever, which are operated by the reversing lever.

In the application of several of these clutches to 68-inch Niles stationary slotters, one of which is shown in Fig. 5, the duty required is very exacting. They are used for all kinds of material, especially steel castings, in slotting out keyways in armature bores; also, facing off pads on the inside of railway motor frames, where it is necessary to have very short strokes and slight clearance at the end of the stroke, especially on the down stroke. In many cases this clearance does not exceed an inch. The slotters under these trying conditions have given every satisfaction and in no case has any breakdown or mishap of any kind been due to their failure to respond at the proper time.

These clutches have been in use for about seven years and have gradually replaced all belt drives on the larger planers, and nearly all of the heavier slotters in the General Electric plant. The amount of air used per stroke is exceedingly small, due to the small clearance in the cylinder. When the hand is held under the discharge pipe only a very slight puff of air is noticeable, while any slight leakage can do no harm; rather would assist in keeping the parts cool. The construction is such as to permit placing on the machine in a compact and pleasing manner, the whole drive making a very simple application that requires very little electrical equipment for its operation. The design is characterized by simplicity and the ease with which one can get at any of its parts at all times for proper cleaning and oiling, also the small amount of care required from the operator.

An Employee's Daily Report Card

Editorial Correspondence

A convenient method of keeping a ready reference history of workmen which serves a useful purpose and requires but little time.

The employees' report shown in the engraving has been devised and applied by the Cincinnati Planer Company in its shops at Oakley. This is a daily report with the upper portion filled in each morning by the time clerk from the record on the time clock, and a copy is placed on the superintendent's desk, while another copy is handed to the general foreman.

If a workman is absent his name and occupation are filled in opposite his check number; and if late the name is placed in the proper column with the number of minutes tardy preceding the name. A glance over the reports for a few days reveals at once any tendency upon the part of individuals to be absent from work or to arrive after the regular starting time and the foreman naturally investigates the matter if any particular name appears with too conspicuous regularity upon the daily reports.

The records also automatically bring to the attention of the superintendent the names of employees who may be more or less delinquent in regard to regularity of working hours, thus he has what may be considered a check upon the attitude of the foreman toward such employees, and in the event of any name appearing too often in the "absent" or "late" columns, he may draw the attention of the foreman to the matter and find out whether it has received due consideration.

It is often the case that a workman, through carelessness or thoughtlessness will be a little late mornings without realizing how frequently this happens. Similarly he may lose more or less time in the course of a few days or weeks without valid reason and perhaps without appreciating just how much time has disappeared in this way. In such cases a record of the kind shown is almost always efficacious in bringing about regularity of attendance during working hours as any departure therefrom is sure to come to the attention of the foreman and superintendent.

Another convenient feature of this "daily report" is found in the lower half, covering the items of "men entering employment" and "men leaving employment." Under the first of these headings are filled in the names of new workmen, with occupations, etc., and these reports thus show to the superintendent just what new men have been taken on in the shop from day to day and what duties they are engaged upon. The section at the bottom of the report explains itself, showing the columns for names, occupations, reasons for leaving. This forms a basis for a permanent record which may be referred to at any time in the future.

The size of the sheet upon which the report is made out is 8½x11 inches and ample space is allowed for the various items to be filled in under the different column headings. The specimen report illustrated is merely filled out in outline to show the general scheme, without covering every item for which there is a place provided on the blank form.

DAILY REPORT OF EMPLOYEES.

Date November 26, 1910.

No.	Absent.	Occupation.	No.	Late.	Occupation.
11	John Jones	Lathe	20 42	15 James Smith 10 Wm. Brown	Bench Planer

MEN ENTERING EMPLOYMENT.

No.	Name.	Address.	Occupation.	Tool Checks.	Locker Keys.	Bench Dw'r.	Started
74	John Green		Lathe				Nov. 26, 10.

MEN LEAVING EMPLOYMENT.

No.	Name.	Dis.-Quit or L. O.	Remarks.	Occupation.	Tool Checks.	Locker Keys.	Bench Dw'r.	Left.
101	A. B. Johnson	Quit		Drill				Nov. 25,'10

Checking Pyrometers in Service

By R. W. Davenport

The principles on which thermo-electric couples are constructed and the construction and operation of the pyrometer. The nature and effect of the constant and transient errors that occur.

Practical and economical ways and means of detecting these errors and correcting or making allowances for them. Necessity of having pyrometers correct.

The extensive use of the thermo-electric pyrometer in industrial operations, involving exact heat treatment, has caused an active desire for technical information that will give the users a general understanding of the principles involved.

Pyrometers are usually rather costly and the purchaser rightly demands interest on this investment in improved results. Therefore, it is up to the man on the "firing line" to choose the right type of instrument, for his purposes and to be able to check its accuracy frequently in the regular course of work. The manufacturers, however, usually withhold technical data along these lines, from a mistaken idea of "policy." I will, therefore endeavor to supply the desired information.

Principle of the Thermo-couple

When two unlike metals are joined at one end and this junction heated, a difference in electric potential, or pressure, is set up between the cold ends of the metals. If these cold ends are joined by a conductor, forming a circuit, an electric current will flow. The intensity of this current is proportional to the difference in temperature between the hot and cold ends of the "couple."

The intensity of the current at any certain temperature is determined by the nature and state of the metals used; some combinations giving a higher voltage than others. The maximum, however, is always very minute as compared to the values commonly found, and it would require hundreds of highly-heated couples to ring an ordinary doorbell.

The cause of the thermo-couple's action is obscure, as are the causes of all electrical-phenomena, but it seems to be due to a direct transformation of heat into electricity rather than a chemical effect like a battery, as the physical state of the metal—its hardness, elasticity, etc., has an important bearing on the effects, and a current may be set up in a single metal bar by differently heating portions which are unequal in hardness. This gives rise to an error known as "parasites" and will be treated later.

The Meter

To measure the intensity of the thermo-couple's current an electric meter is necessary. The type universally used is similar or identical to the ordinary voltmeter or ammeter used on commercial direct currents.

These meters are operated in a manner similar to the direct-current electric motor. The armature, instead of completely and freely revolving, turns against springs through an angle of about 45 degrees. This armature consists of a light coil of copper wire suspended between the poles or ends of a horseshoe magnet; so it will swing with a minimum of friction. It is provided with a pointer that swings over a scale graduated from normal or zero. The movement of this pointer is proportional to the strength of the current flowing through the meter.

In a pyrometer, the electric current being very small, a commercial volt or ammeter is seldom used. The best results are only attained by a specially built meter in which the armature may be operated by a small part of the minute current available and still be free from friction.

The movement of the pointer of a meter may be permanently recorded in several ways. A chart is sometimes made to move at regular speed under the needle, which usually carries a small quantity of ink or a lead and is periodically pressed onto the paper by clockwork. Any method, whereby the needle touches the chart is productive of error, however, and the ink marks are easily forged. An electric spark, jumping from the pointer's end through the chart affords a frictionless movement and an inimitable record.

Constant Errors

With a clear understanding of the principles involved, it is well to analyze the errors that exist in most pyrometers, and to suggest means for their detection and allowance. These are of two general classes, i.e., constant errors due to inherent conditions and transient errors due either to a temporary or permanent change, after the instrument is calibrated.

Constant or inherent errors are due to several facts. The thermo-couple gives a current proportional, not to the temperature at one end, but to the difference in temperature between the end in the furnace and the end outside. Hence, if your meter reads, say 1820, it means that, other factors being correct, the furnace is at 1820 less the temperature of the air surrounding the outer end of the couple. Most pyrometers are calibrated with the cold end at about 80 degrees Fahrenheit and unless kept at this temperature, must be corrected.

This is easily effected by attaching a thermometer to the cold ends of all couples and subtracting from the pyrometer reading, any difference between the calibrated temperature and the thermometers indication. The cold end error may be almost eliminated, however, by properly designing the couple. To determine the extent of the error, simply keep the hot end at constant temperature while varying the cold end through, say 10 degrees, with a thermometer attached. Note any variation of the meter reading and by dividing that amount by 10, you have the percentage of error.

Lag

Thermo-couples are frequently provided with protection tubes which offer considerable resistance to the transfer of heat. This causes a time lag, that is, the couple heats more slowly than the surrounding air and never reaches the full temperature of the fire. To find this absorption error, simply observe temperatures both with and without the protection and divide the difference by the temperature unprotected. This gives the percentage. Once determined, this factor should always be considered if a knowledge of absolute temperature is desired, and the lag of the couple must be allowed for if the time element is of importance in any particular operation.

The moving coil of copper wire in the meter changes in resistance with any change in its temperature. The amount of current it carries determines the meter's reading, and since, if the resistance increases, less current will be allowed to flow, a rise in the meter's temperature will lower its reading, irrespective of the temperature at the hot end of the couple. In some designs this error may reach as high as 3 per cent. for every 10 degrees Fahrenheit rise or fall in the temperature of the meter.

To determine whether it is fully or partly compensated, ascertain the temperature of the meter by inserting a thermometer into the case, or attaching it to the outside. Then be sure that the meter has reached the temperature of the air by allowing some time for it to "soak." After that check the meter at a standard point. After noting the meter's reading and temperature, raise or lower its tem-

perature by an air blast or any other convenient means, by as nearly 10 degrees as possible. Upon again getting a standard point the extent of the error is at once apparent in any discrepancy between this and the former point. The amount of the discrepancy divided by the difference in meter temperatures gives the percentage error.

Transient Errors

There are several errors of a changing value to which most pyrometers are subject, the only check on them being to try the meter frequently at standard points. This method is based on the peculiar behavior of certain metals when passing from a solid to a molten state, or *vice versa*. The temperature of a pure metal, say copper, may be raised evenly to about 1970 degrees Fahrenheit. Above this point it begins to lag and although the furnace be constant, more and more of the applied heat seems to be used up in the copper itself.

At about 1980 degrees Fahrenheit the metal changes from a solid to a liquid and at this point all the applied heat is used up in internal changes in the structure of the metal, consequently there is a "hold" in temperature. This point has been accurately determined for several metals, and while it varies slightly with their purity, it is the most reliable standard known. For copper, this point is 1981 degrees, for aluminum 1216 degrees and for zinc 786 degrees Fahrenheit.

These metals, in the form of wire, about No. 10 in size, and of chemical purity, should be kept at hand at all times and used in the following manner: The metal chosen must be determined by the range of the instrument; the melting point preferably falling at about three-fourths of the full-scale reading. The wire should be wound around the fire-end of the couple for a space of about three inches, being careful to cover the actual end of the couple. All protection must be removed except the porcelain tube, in the case of platinum couples. The wire-wound couple must then be inserted into a furnace whose heat is from one to two hundred degrees higher than the chosen holding point, and at a constant temperature.

The meter, upon being connected, will show a rapid increase until within about 10 degrees of the point when its pointer will advance more and more slowly and finally stop. It is well to let the couple remain in the furnace until it reaches its limit and it is also advisable to watch the test wire when it nears the point, as it should begin to drop off at about the same moment the needle is again proceeding. The difference, if any, between the meter's reading and the point chosen is its total error at that time. When divided by the standard point, it gives the percentage.

Parasite Errors

The cause of the variable errors lies in the fact that the couple itself changes in structure after long exposure to heat, thus making parts of its length different in character. To detect the presence of these "parasite" errors, the wires or elements of the couple should be removed from the protection and separated a couple of inches in the middle. The meter should then be connected and a Bunsen burner or blowpipe supplied to but one of the elements. This should be started about 3 inches from the joint and worked slowly toward the cold end; following the burner with a wet cloth, thus causing a large difference in temperature between points of the wire quite close together. There should be no reading whatever, either forward or backward, on the meter. The other elements should then be treated similarly.

It is almost impossible to check these parasite errors in definite values and the best thing to do is to discard any couple known to have them, rather than attempt to allow for them.

Another variable error common to the commercial volt-meter type of pyrometer is known as drag. Double-pivot instruments, especially portable ones, are apt to have considerable friction in the armature mounting and this usually increases with the age and extent of rough usage of the meter. The drag of any meter may be shown up by smartly tapping its case with a pencil, after the needle has settled, upon starting from zero or upon returning to zero. It is well to always tap a meter before reading when it is known to drag, as the amount varies so greatly.

Summary

A pyrometer that will survive all the tests I have described with a perfect score, would be very nearly perfect, and its accuracy would be extreme. For industrial use, however, such precision is never required, and if the total errors are within 5 per cent., very valuable service will be obtained from your pyrometer. But seldom is even this degree of accuracy maintained, and when all the errors add up, as they sometimes do, a pyrometer becomes a false sign post, that is, worse than useless. At least two different types of instrument are usually advisable, one to check the other, and most users so equip themselves. But this, while it shows that something is wrong somewhere, does not give exact figures in percentage of accuracy, nor does it insure correct results as both instruments may be in error at the same time.

The Differential Piece Rate

In the article under this heading, appearing on page 18, it was intended to include the accompanying table, giving an example of the working of the method under discussion, so that it might possibly be better understood.

	Time Allowed.	Time Taken.	High Rate.	
	3.40	3.30	$0.390	Paid at high rate.
	6.84	4.80	0.787	
	5.36	5.20	0.616	
	2.50	2.60	0.288	
	1.90	1.80	0.219	
	2.40	2.30	0.276	
	1.40	1.50	0.161	
	0.97	0.80	0.112	
Totals	24.77	22.30	$2.85	
(*)		1.80	0.290	Balance due on jobs carried over from previous days and finished to-day.
		2.50	0.200	(Difference between amount advanced and piece-work price.)
		0.60	0.050	Money advanced on unfinished jobs, paid at machine hour base rate.
		1.70	0.150	
Total hours worked.....		28.90	$3.54	Total wages for day.

(*) Note.—On this day the operator failed to complete the two jobs carried over, in the time specified, but the time lost was counterbalanced by the time gained on all other piece-work jobs worked on during the day; he was, therefore, paid the high rate on these two jobs.

Example of Working of This Method.

A German inventor has devised, according to the *Scientific American*, a very ingenious construction of masts made of steel bands running lengthwise of the mast and transverse connecting members for holding the steel bands together to form a tubular structure of square or polygonal cross-section. Portable masts are made in hights varying from 6 to 130 feet, with either four or six steel bands of best quality, their width being either 1¼, or 2½, or 4 inches. The bands are wound on four or six drums, as the case may be. For very small sizes (up to 17 feet) spring drums are used, and the mast is pushed up or drawn down by means of two wheels the teeth of which fit into corresponding holes in two opposite bands. For the larger sizes, the drums are rotated by means of cranks, and the raising of the mast is effected by means of a hoisting device of various forms, which makes a rather striking picture in action.

National Museum of Art and Industry

By L. P. Alford

The old National Museum building in Washington, largely vacated by the removal of specimens to the new Natural History building, is to be used for a National Museum of Arts and Industry. The care and maintenance of these museums is one of the activities of the Smithsonian Institution.

The United States is about to have a National Museum of Art and Industry. To every patriotic American, and especially to those who have visited the Science Museum at South Kensington, or the Conservatoire Nationale des Arts et Metiers in Paris, or the great Deutsches Museum von Meisterwerken der Naturwissenchaft und Technik in Munich, this announcement should be welcome news. A further cause for gratification lies in the fact that the museum is to be located in that city of all cities in the United States most suitable for such a purpose, our national capital city of Washington, and still more, the museum is under the patronage of our National Congress.

The nucleus for this great representative exhibition of the arts and industries already exists in many specimens now in the possession of the National Museum, the care and maintenance of which is one of the activities of the Smithsonian Institution. To show the development of the movement which is soon to reach fruition, it is necessary to trace a little of that institution's history. Under date of December 6, 1838, the President announced to Congress the receipt in this country and the investment of Smithson's bequest amounting to a little more than half a million dollars and invited the attention of that body to the obligation devolving upon the United States to fulfill the object of that bequest. Congress considered this matter for several years and at length passed a bill which received the President's approval on August 10, 1846. Broadly this gave the Smithsonian Institution the custody of National collections and provided for a site and building. On May 1, 1847, the cornerstone of this building was laid with imposing Masonic ceremonies. The building was carried on slowly as funds became available and was not entirely finished until the year 1855. The whole amount expended on the building, grounds, and objects connected therewith was $318,727.01.

It was planned to accommodate a museum, a library and the administrative offices of the institution. In 1858 a transfer of specimens from the Patent Office was made and Congress began to make appropriations for the museum's maintenance. These collections increased so rapidly that in 1875 they were occupying nearly three-fourths of the Smithsonian building, and in fact all parts not actually required for the activities of the parent institution, the administrative offices and the exchange service.

At the close of the Centennial Exposition in 1876 some 30 foreign nations donated their exhibits to our Federal Government and their example was followed by many private foreign and domestic exhibitors. In all some 80 carloads of specimens were thus transferred to the custody of the Government of the United States.

The National Museum Building

The Smithsonian Institution, the custodian of national collections by law, had no place to store or exhibit this great number of valuable objects. Congress was at once asked for an appropriation to erect a suitable national museum building. In 1880 an item was passed in the sundry civil act of that year, providing $250,000 for a fireproof building for the use of a National Museum. This building was completed during the following two years, the final report of the building commission being dated January 2, 1882. Its cost, together with the apparatus for heating, lighting, etc., totaled $315,400.

This building and the older building of the Smithsonian Institution are the two buildings so well known to visitors in Washington, occupying as they do an important site in Smithsonian Park.

It is an interesting historical incident that the first use of the National museum building was for the inaugural reception of President Garfield, on March 4, 1881.

Early Intention to Found a Museum of Arts and Industry

Turning now to the early days of the Smithsonian Institution, it is with gratification, indeed admiration, that we find the art and industrial side of the museum to have been in the mind of the first board of regents appointed to administer the institution's affairs. In reports of a committee of that board submitted in December and January, 1847, we find these paragraphs; "Your committee are further of opinion that in a museum, if the funds of the Institution permits, might judiciously be included various series of models illustrating the progress of some of the most useful inventions; such, for example, as the steam engine from its earliest and crudest form to its most improved state; but this they purpose only so far as it may not encroach on ground already covered by the numerous models in the Patent Office.

"Specimens of staple material, of their gradual manufacture, and in the finished product of manufactures and the arts, may also, your committee think, be usefully introduced. This would supply opportunities to examine samples of the best manufactured articles our country afford, and to judge her gradual progress in arts and manufacture.————"

Is it not a pity that Congress has been so shortsighted as to have failed until the present time, to furnish funds for carrying out this plan, outlined as it is in such a comprehensive form? Had this been done, we would without doubt have today the most splendid museum of its kind in the world; but prospecting is of more value than retrospecting and we are just on the eve of seeing this admirable outline of museum policy put into full effect.

The New Natural History Building

The building of the National Museum which was completed in 1881 was immediately filled with specimens and as early as the next year the need for a new building was apparent and a bill was introduced into Congress to appropriate a sum of money for that purpose. Throughout the period of succeeding Congresses efforts were made to obtain funds for additional museum buildings, while conditions grew constantly worse. Many valuable specimens could not be exhibited at all for lack of space, others were withdrawn from exhibition and much storage space hired in the city of Washington in order to house these valuable objects. On June 30, 1904, a bill was finally agreed to in conference as an item in the sundry civil act for that year, making the initial appropriation for a new museum building, the total cost of which was not to exceed $3,500,000. This splendid building of granite laid in ashlar courses, is now nearly completed—in fact a visitor to Washington today can enter many of the rooms where exhibits have already been placed or are being arranged. It is expected that a formal opening will be held early in 1911, before the adjournment of the present Congress.

This new building will be devoted almost entirely to natural history, and will, therefore, receive the greater portion of the specimens formerly on view in the old National Museum building. In fact, at the time of this writing the work of transfer from the old to the new building

is well under way and is progressing rapidly.

Old National Museum Building to be Devoted to the Arts and Industries

This removal of the greater portion of the exhibits from the older building brings about the opportunity for developing the National Museum of Art and Industry. The plans for its establishment have been carefully worked out by Charles D. Walcott, secretary of the Smithsonian Institution, and by Richard Rathburn, assistant secretary in charge of the National Museum. Already many specimens are on view and more are in storage. In fact it is well worth the time of any visitor to Washington who is interested in industrial development to visit the old National Museum building and study the exhibits already on view. Many of these specimens are models from the Patent Office, others have been the gifts of individuals, and still others of manufacturing firms.

A Few Specimens Now on View

Without in any way attempting to present a catalog list of what can now be seen, a few objects can be mentioned with interest and profit. Among the mechanical models we find one of a turning lathe, invented by Thomas Blanchard and patented in 1843, in all essential particulars the same machine as is used today for turning shoe lasts. Two models can be seen of Ely Whitney's cotton gin, bearing the date of 1794. The early models of the phonographs occupy a portion of a large case, and not far distant is a series of exhibits of the early works of Samuel B. Morse, in connection with the electric telegraph. Sewing-machine development is traced by 17 models.

In the steam-engine field one large case contains the cylinder of the first steam engine ever operated in the United States. This cylinder bears the following inscription:

"The steam engine of which this is a portion of the cylinder was the first ever erected on this continent. It was imported from England in the year 1753 by Col. John Schuyler for the purpose of pumping the water from his copper mine opposite Belleville, near Newark, N. J. The mine was rich in ore, but had been worked as deep as hand or horse power could clear it of water.

"Colonel Schuyler having heard of the success with which steam engines—then called fire engines——were used in the mines of Cornwall, determined to have one in his mine, and accordingly requested his London correspondent to procure an engine and to send out with it an engineer capable of putting it up and in operation. This was done in the year named and Josiah Hornblower, a young man then in his twenty-fifth year, was sent out to superintend it.

"Mr. Hornblower's father, whose name was Joseph, had been engaged in the business of constructing engines in Cornwall from their first introduction in the mines there—about 1740—and had been an engineer and engine builder from the first use of steam engines in the art—about 1720.

"The engines constructed by him and his sons were the kind known as Newcomen engines, or Cornish engines. That brought to America by Josiah was of this construction. Watt had not then invented his separate condenser, nor the use of high pressure, but it is generally said that for the pumping purpose the Cornish engine has still no superior.

"About 1760 the Cornish mine was worked for several years by Mr. Hornblower himself. The approach of the war in 1775 caused its operation to cease. Work was resumed, however, in 1792 and was carried on for several years by successive parties. It finally ceased altogether in this century and the old engine was broken up and the materials disposed of. The boiler, a large copper cylinder standing upright, 8 or 10 feet high and as large in diameter, with a flat bottom and dome-shaped top, was carried to Philadelphia. A portion of the cylinder was purchased by some person in Newark.

"In 1864 I met an old man named John Van Emburgh, then 100 years old, who had worked on the engine when it was in operation in 1792. He described it very minutely, and I doubt not accurately. It is from his description that I happen to know the kind of engine it was although from the date of its construction and the use to which it was put there could have been little doubt upon the subject."

The early work of John Ericsson is shown by several air-engine models, a steam-engine model showing the engine crosswise of the boat and connected to the propeller shaft to link-and-lever mechanism, and a so called expansion steam engine of the date of 1849.

In the gas-engine field we find exhibits showing the early work of Stuart Perry and Brayton.

The automobile field is represented by a small model, upon which the patent of George B. Selden was based—a model showing in all essential particulars the automobile of today. Turning from the models to full-sized operating mechanism, we find a Haynes automobile of the year 1893 bearing the legend: "First car made in America."

Two invaluable exhibits in the field of locomotive development are the locomotives "John Bull" and "Stourbridge Lion." The "John Bull" is the oldest complete locomotive in America. It was built by George Stevenson & Sons, Newcastle-on-Tyne, England, in 1830 and 1831, and shipped from Liverpool July 14, 1831. It was locomotive No. 1, of the Camden & Amboy Railroad Company, entering into service in 1831. The "Stourbridge Lion" was made in England and shipped to America in 1829.

Transportation by water has been worked out in a series of most interesting models, beginning with the simplest kind of a floating raft and ending with na ocean liner. Of special interest are models of Stevens' steamboat, Fitch's steamboat with oars, of the date of 1786, and Fulton's "Clermont."

In the field of machine tools one seeks in vain for the history of one of America's most important industries, a world industry which has been developed so largely on this side of the Atlantic. The nearest approach to this field is two neighboring exhibits; Ramsden's dividing engine and his slide rest. The inscription on the dividing engine reads as follows: "For accurately dividing the circular scales of astronomical instruments and engineering engines. Designed and constructed by Jesse Ramsden, of London, England, in 1775." The legend on the slide rest reads: "Used in making screw bit with which the 2160 teeth in the edge of the wheel of the Ramsden dividing engine were cut. Designed and constructed by Jesse Ramsden, of London, England, in 1775."

In the Field of Aviation

The newer art and industry of aviation is somewhat better represented, for suspended in one of the wings of the museum building are three Langley model aeroplanes, the first of 1896, the second of 1898, the third of 1903. In a nearby case is Langley's aëroplane engine, a priceless treasure. In another are three models, one-fourth original size, of the gliding machine and with which the late Octave Chanute successfully experimented. They comprise the biplane of 1896, the multiple wing of 1896 and the oscillating wing of 1901 and 1902. The Aërial Experiment Association has presented through Dr. Alexander Graham Bell an exceptionally fine collection of 76 large photographs of the Wright aëroplane, taken during the period of testing by Orville Wright, at Fort Meyer, Virginia, September, 1908. These constitute a most valuable historical record of this important epoch in the history of air navigation.

Space does not permit me to mention more of these interesting historical objects, and, in fact, no good purpose would be served by so doing. Enough has been presented to show that the National Museum already possesses the nucleus of a museum of American art and industry, and that the opportunity is directly in front of us to build this museum into the most splendid collection of its kind in the world.

All of this must be a source of the greatest gratification to each one who is really interested in the development, progress and history of American industry.

Letters from Practical Men

Concerning the details of making things in machine shops, from the first sketch to the shipping room. A letter good enough to print will be paid for. The value is in the idea—not the length of the letter

A Pneumatic Milling Fixture

The pneumatic vise illustrated herewith is used in the shops of the Cincinnati Milling Machine Company and has proved to be a very useful and satisfactory tool.

The operation of the vise is as follows: Air at 80 pounds pressure per square inch is admitted to the chamber *A*, through the pipe *B* and cock *C*, and forces in the piston plunger *D*. Motion is transmitted to the movable jaw *E* through the link *F*, causing the jaw to clamp the work securely.

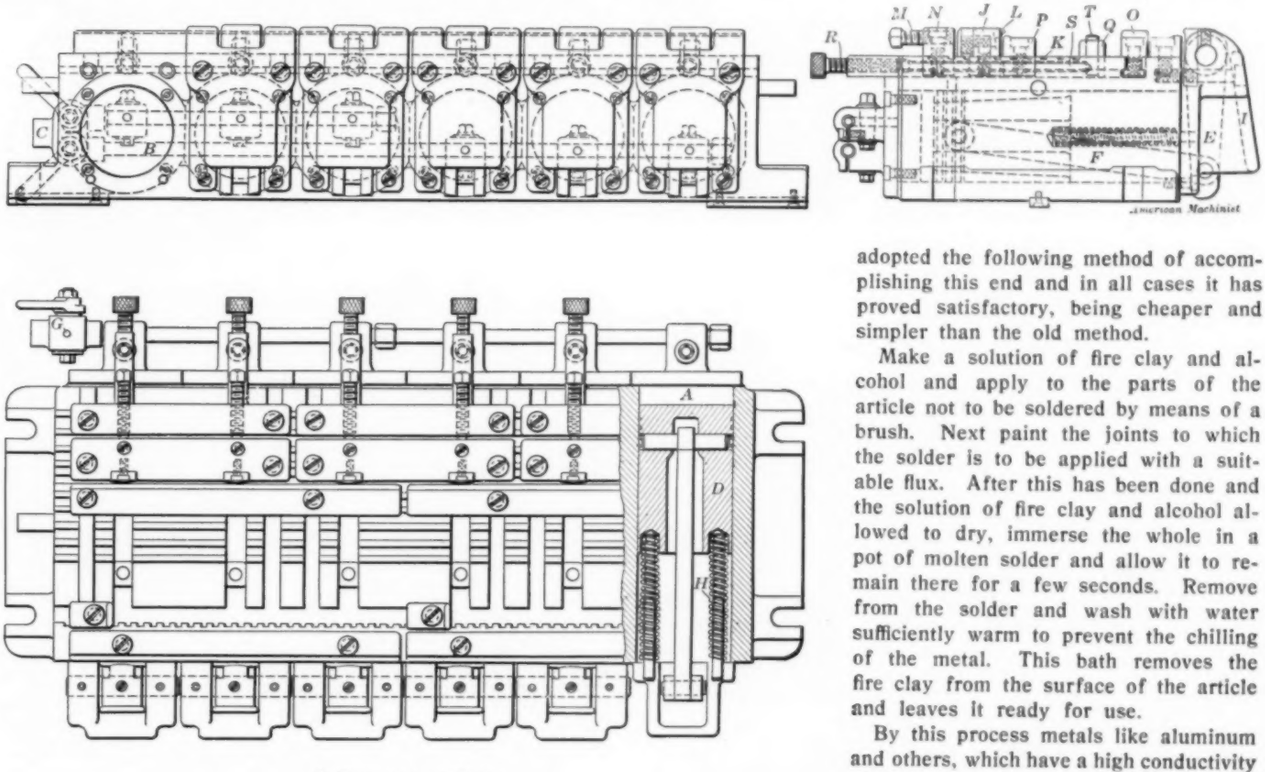
To release the work the air cock is closed, and the pressure against the piston is relieved by the air escaping through the exhaust opening *G*, and the piston and jaw are returned to normal position by the springs *H*. *I* is a cast piece serving as a cover for the working parts of the jaw.

It will be noticed from the construction of the air cock that either three or six of the jaws can be operated, depending on the size of the work. *J* is the back or fixed jaw. It is fastened in the slots *K*, and can be adjusted back and forth. Hardened pieces *L* are provided for bearing against the work. The setscrews *M* are carried in the backing strips *N* and are tightened against the fixed jaw to give it greater rigidity. This work is positioned lengthwise against the adjustable stops *O*, and is supported by the bearing strips *P* and the blocks *Q*, which latter are provided with pins *T*, the hight of which is adjustable by the screw *R* and pin *S*..

This vise, with its various adjustments, covers a wide range of adaptability, and many pieces of varying size can be handled in it.

One point to be borne in mind regarding pneumatic fixtures is that the work must be timed so as to insure the completion of a cut once started before the machinery is shut down for the day, or else the fixture will release the work in the machine, and the piece will have to be done over, as it is practically impossible to replace the work in exactly the same position in the fixture.

Philadelphia, Penn. T. H. HARRIS.



A PNEUMATIC VISE

Removing Blots from Tracing Cloth

Though not generally known, perhaps, spirits of camphor applied with a rag will remove those inevitable ink blots on tracing cloth, leaving the cloth in much better shape than if some mechanical means were employed. It may also be used to good advantage for erasing lines and figures if the rag is drawn over a pencil point or pointed stick. The texture of the cloth is unchanged by the camphor.

Cincinnati, Ohio. R. A. RUDOLPH.

A Method of Soldering Parts by Dipping

In large manufacturing establishments where a large number of soldered joints are used, soldering by means of the soldering iron and plumber's torch, is found to be a very expensive process. Many manufacturing concerns have adopted the following method of accomplishing this end and in all cases it has proved satisfactory, being cheaper and simpler than the old method.

Make a solution of fire clay and alcohol and apply to the parts of the article not to be soldered by means of a brush. Next paint the joints to which the solder is to be applied with a suitable flux. After this has been done and the solution of fire clay and alcohol allowed to dry, immerse the whole in a pot of molten solder and allow it to remain there for a few seconds. Remove from the solder and wash with water sufficiently warm to prevent the chilling of the metal. This bath removes the fire clay from the surface of the article and leaves it ready for use.

By this process metals like aluminum and others, which have a high conductivity of heat, can be readily soldered due to

the fact that the heat is not withdrawn from the surfaces to be soldered as in the case where the iron is used. A special flux such as chloride of silver should be used when soldering aluminum.

Indianapolis, Ind. F. B. HAYS.

Method of Imparting a Gun Metal Finish to Aluminum and Die Cast Parts

The parts to be treated should have a smooth surface, free from blow holes or fins.

The process of imparting the desired finish is as follows: Make up a solution of 12 parts hydrochloric acid; 1 part chloride of antimony, and 87 parts water. The solution should be contained in an earthen or glass vessel of ample size to allow for space between the parts when dipping.

Fasten the parts to be stained on a wire, and place them in the solution; allowing them to remain immersed for from six to ten seconds; then remove quickly and place in a bath of running water for several minutes.

Remove the parts from the water bath, and dry in the air or in an oven, whichever is more convenient. When thoroughly dry buff the stained surfaces lightly on a high-speed buffing wheel. The parts will then be found to have a dark lustrous surface similar to that of gun metal.

If it is desirable to have a part of the surface stained, and the remainder retain its natural color, the latter may be coated with paraffin or some other substance not attacked by the solution.

The depth of penetration of the stain depends upon the length of time the parts are immersed. A weaker solution should be used when the parts are to be immersed for any considerable length of time, as the acid in the solution attacks the surface of the metal and eats it away.

Indianapolis, Ind. F. B. H.

Correcting Wrongly Drilled Holes

It frequently occurs (in jobbing shops especially, and occasionally in other places, where jigs are not employed on the work) that drilled holes in the work have been improperly spaced and have to be changed ⅛ or ¼ of their diameter in some direction.

Instead of the usual chipping and filing process so often resorted to, a much neater and more satisfactory job is obtained by taking a piece of flat bar iron, about ⅝ inch thick, drilling a hole through it the size wanted in the work, and then clamping this piece of iron with the hole in it exactly over the location wanted for the hole in the work, running the drill through and the mistake is satisfactorily corrected in a jiffy.

H. R. G.

A Micrometer Surface Gage

The accompany cut shows how I made my inside micrometer serve the purpose of a micrometer surface gage. It is a valuable addition to my tool kit.

W is a steel block, ¾x2x2 inches, bored a snug fit for a thimble of an inside micrometer. It is held sufficiently rigid by the thumb screw in the side. *X* is a sliding fit in the ¼-in. hole in the block and is provided with a split bushing to fit the micrometer, the small thumb screw being released when adjusting for hight in order to permit the rotation of the micrometer barrel.

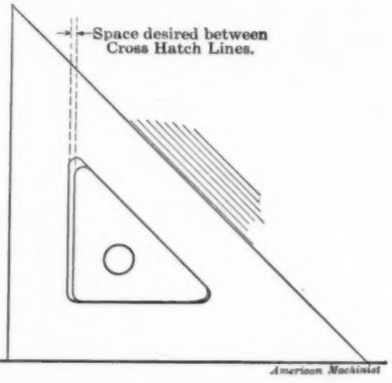
Y is a split bushing made to fit the scriber holding the knuckle of a small Starrett surface gage. This bushing could be dispensed with to advantage by the use of a standard made to fit the knuckle without bushing it. *A* and *B* are the distance pieces employed to increase the length of the micrometer, in this case the hight.

In practice I set the micrometer in the block with a piece of paper of a known thickness intervening at *E*, thus saving the wear occasioned if the contact were direct with the bottom surface.

Cleveland, Ohio. PAUL CAMPBELL.

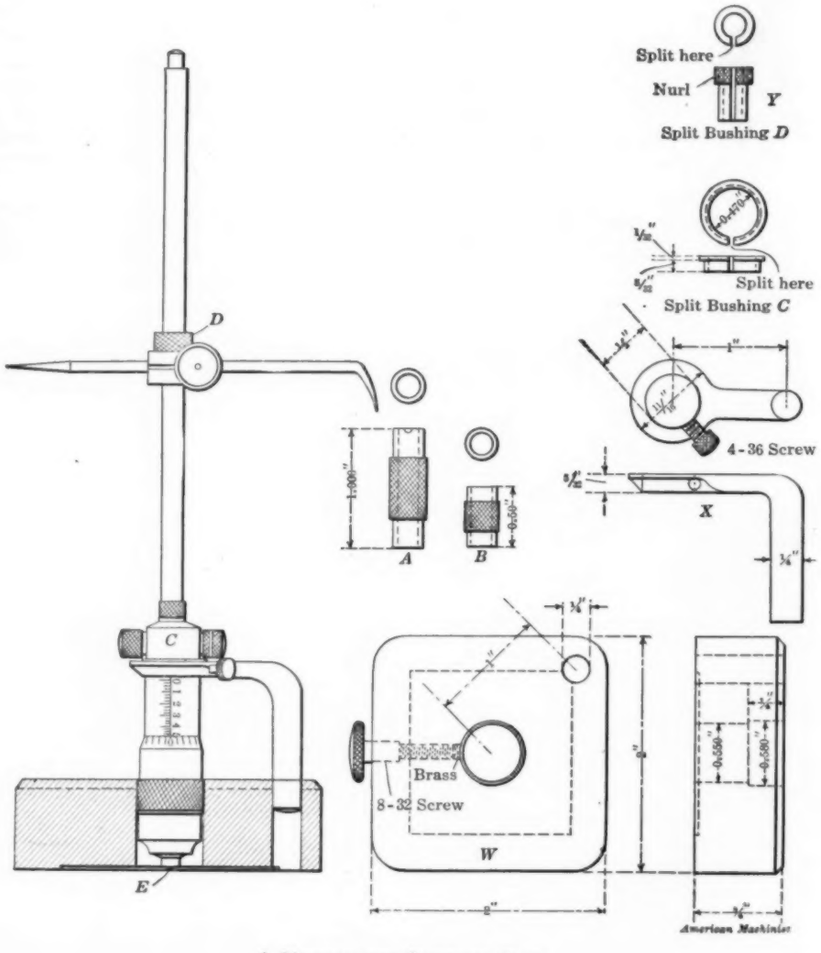
More Draftsman's Kinks

Following are a few of the draftsman's helps that I have picked up and which I don't believe are generally known among the pencil pushers.



CROSSHATCHING DEVICE FOR TRIANGLE

The first is a spacer or cross-hatcher, shown in the illustration. It is whittled out of 1/16 or 3/32 inch hard wood, cut so that it has play between it and the inside edge of the triangle equal to the desired space between the cross-hatch lines. With a little practice, one can become so



A MICROMETER SURFACE GAGE

proficient that he can beat any machine I have ever seen.

In running from right to left, say, the right hand naturally rests upon the triangle while supporting the pen or pencil. Allow the left to hold the block. Immediately upon finishing the line, move the spacer as far as you can, holding the triangle stationary, with the right hand resting upon the triangle in the natural position it assumed after finishing the stroke. Next, move the triangle along the tee-square until it again rests against the spacer, by a slight shove as your right hand goes forward to execute the next line. Try it; and you will be surprised how easy it is, and how rapidly you can make uniform cross-sectioning.

When working on a big tracing, I have found it very helpful to paste a piece of blotting paper and a piece of drawing paper on my tee-square. The blotting paper is used as a coaxer for the ink when it refuses to flow, instead of my fingers. The drawing paper in this position saves reaching over to the edge, when the width of line is to be adjusted.

Some time ago I saw a little hint in the AMERICAN MACHINIST that has turned out a material aid to me. It is worth reprinting. It was to cut a flat surface where the thumb rests on the inkbottle cork when the quill is in the proper position for filling the pen. Such a flat will not only save a second or two, as the notice said, every time the pen is filled; but it will also make the cork much more easy to remove from the bottle, and will prevent the cork from rolling over a valuable tracing when laid upon the table.

Moline, Ill. D. F. HARRISON.

Adjustable Holder for Thread Cutter

The thread cutter holder and grinding block shown in the accompanying illustrations were designed to give a more perfect thread on master taps and, as it has proved very satisfactory, it is detailed in full so that anyone wishing to make one may do so with but little expense.

The ordinary, solid threading-tool holder answers for most cases; but the nearer the tool can be set to the angle of the thread, and the tool accurately ground to the proper angle, which in the tool changes from 60 degrees according to the pitch, the better will be the results.

I remember, on one occasion, working in a factory where large numbers of fine-threaded screws were used, similar to

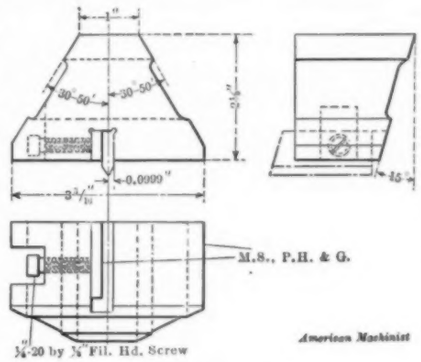


FIG. 2. THREAD-TOOL GRINDING BLOCK

those used in phonographs. They were mostly 100 threads per inch and were made with a die run on one end and off the other, so as not to drag off the cutting edge of the die; after which they were chased in a lathe, with a circular chaser made double pitch.

They had made and used thousands of these and always had lots of trouble with the chasers, so I had one drawn up and made with the idea of trying to locate the trouble. The chaser was marked "50 threads per inch, Left Hand." One day shortly after, while I was in the tool room, the head toolmaker said, "You made a nice bull on that thread chaser." I said, "How is that?" "Why, your man put on it, 'Left Hand,' and those screws are right hand." Well, I had no more trouble locating the fault of poor threads. I had quite a time showing him how the angle on the chaser led back on the back side and forward on the front. This goes to show that it is possible to get some kind of result even with poor threading tools.

The method used where I introduced this tool, is to make master taps for cutting manufacturing dies, also master taps for making master dies. There are usually six taps used for each, and great care is taken in cutting.

It will be noted that the point of the cutter is on center at all times; no matter what angle the cutter is thrown to, the point does not change. To set the cutter, all that is necessary is to slide it up level with top of holder, usually by placing a scale on top of the holder and bringing the tool up until it touches the scale; then, from the table take your angle and set the tool over the required amount and proceed. This tool was designed for a No. 10 P. & W. lathe.

The table for setting tool for different pitch threads is as follows:

TABLE OF ANGLES.

Tap.	Degrees.	Grad.
0.047–100	3° 52′	7⅛
0.058– 72	4° 21′	8
0.073– 64	3° 54′	7⅛
0.093– 64	3° 3′	6
0.125– 40	3° 39′	7
0.150– 40	3° 2′	6
0.187– 36	2° 42′	5
0.250– 32	2° 17′	4½
0.312– 30	1° 57′	4

The grinding block is designed to give the proper angle to the cutter, which changes from sixty degrees as the tool is thrown to the angle of pitch. The cutter is clamped in, and both sides of the angle, the top of the cutter and the flat on the point, are all ground without removing the cutter from the holder.

Harrisburg, Penn. C. A. T.

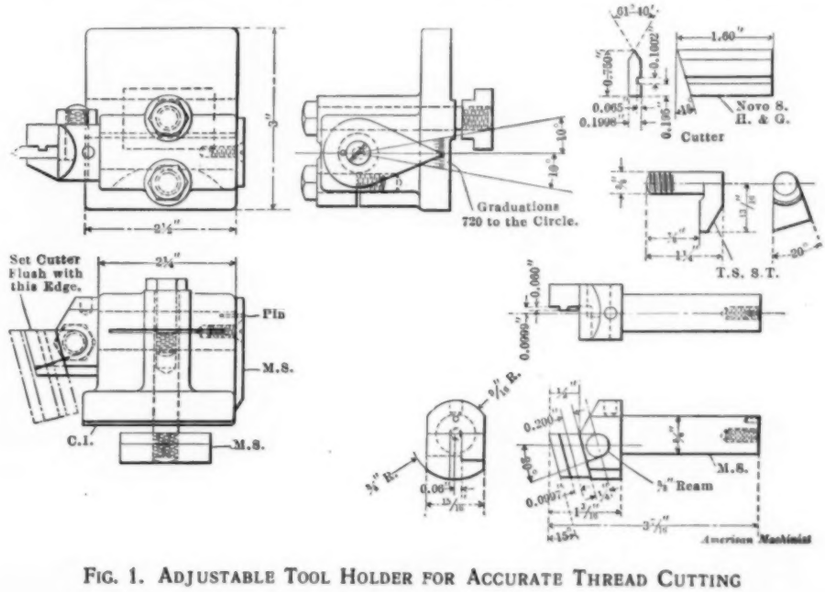


FIG. 1. ADJUSTABLE TOOL HOLDER FOR ACCURATE THREAD CUTTING

Hardening Thin Edge Tools

Having noticed a good many failures in hardening tools that are drawn down to a thin edge, such as chisels, axes, plane bits, etc., chiefly through cracking. I offer a few suggestions for consideration.

First, the warping and springing of steel is mostly due to the heat and not, as many suppose, to the cooling bath. This can readily be demonstrated by laying a long piece of steel on a fire, where the heat will strike it unevenly, and taking note of the change by sighting over its top. Thus, the first important point is to have the heat strike evenly on all sides of piece.

In hardening such a piece as an ax, (and this applies to all thin-edge tools of the same nature) raise it to the proper heat very slowly, and with as little blast as possible, and then plunge it in the quenching bath straight down and head first; in other words, the thin or cutting edge should be immersed last. After cooling, immediately hold it over the flame of the fire until the water rolls up and runs around on the surface. Tools treated in this way will never crack.

A very good bath for delicate work is hot water. This, in a great many cases, gives the right degree of hardness without having to draw down afterward.

To temper knives, or any thin tools, two flat pieces of metal should be used. Lay one plate down flat and spread enough oil on it to envelop the piece to be hardened. After that give the piece its proper heat, quickly lay it on the plate and cover immediately with the second flat piece, or plate. If properly done the work will come out straight.

Kenosha, Wis. W. A. JAMES.

Tool Steel Economy

The introduction of high-speed tool steel and the favorable results that have attended its use have resulted in the discarding of most of the old self-hardening steels, such as Mushet and Sanderson. In many shops there are hundreds of pounds, in the shape of discarded tools, and many dollars are tied up in it. As scrap it will not pay to sell it, and yet, to the casual observer, it is of no practical use in the shop.

In our plant there is about 1500 pounds of such steel and I was instructed to experiment and find some purpose for which it could be profitably used.

By placing the steel in short pieces of wrought-iron pipe, packing it tightly with powdered lime, stopping the ends of the pipe with fire clay, heating slowly to as high a temperature as the pipe would stand and then burying in a box of sand over night. I annealed it so that the ease with which it could be milled, planed and shaped was surprising. The steel was then made up into counterbore cutters, taps, dies and tools for other purposes, where high cutting speeds are not essential. These tools are giving much better service than those made from the steels formerly used for this purpose.

Another great waste in the matter of tool steels, occurs from the fact that tools become worn down or broken so short that they seem to be of no further service and are thrown in the scrap and sold for little or nothing.

To overcome this I collected a large number of short pieces of Novo and Novo Superior steels in sizes 1x2, ¾x1½ and ⅝x1¼ inches, ranging from 3 to 6 inches in length. I then slowly and thoroughly heated them and drew them out in sizes ½ and ¾ inch square, and ½x1 inch. This made them long enough to make up into lathe and boring tools and we found that the quality of the steel suffered no impairment from the treatment.

I treated 27 pounds of these pieces, from the scrap pile, and had 26½ pounds of small steel. I kept strict account of labor, coal, steam, etc., and found that it had cost less than 11 cents per pound to transform this scrap steel (worth about 8 cents per pound), into thoroughly good tool steel worth from 70 to 90 cents per pound.

Holyoke, Mass. L. E. DICKINSON.

Parallel Attachment for Drawing Board

The price of parallel attachments made by most of the drawing-supply companies is such as to make it cheaper in most cases to make them up in the shop. The one shown in the accompanying illustrations can be made with very little expense, and is the most satisfactory one I have ever seen.

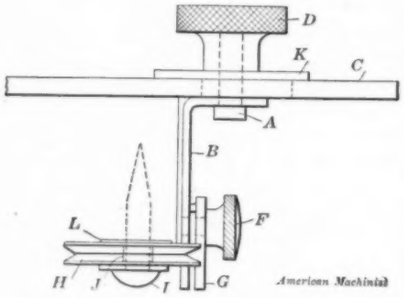


FIG. 1. PARTS FOR PARALLEL ATTACHMENT FOR DRAWING BOARD

An assembled view is shown in Fig. 1, and details in Fig. 2. The screw *A*, which is sweat-soldered to the bracket *B*, projects through a hole in the straight-edge *C*, and the bracket is secured in place by the nurled nut *D*. The screw *F* and flat piece *G* are fastened to the bracket and serve to clamp the wire which is strung around the board on the sheave wheels *H*, which are fastened to the under side at the corners, by the wood screws *I*. The rollers revolve on the bushings *J*, which are of two lengths, as two rollers are used in the rear, and only one at the front of the board.

Washer *K* is placed between the straight-edge and the nurled nut, and washer *L* under the rollers, next to the board, and between the two rollers on the double sheaves at the back.

T. H. SYLVAN.

Philadelphia, Penn.

There was described in a paper presented before the last annual convention of the Society of Naval Architects and Marine Engineers two successful gas-producer gas-engine plants for marine propulsion, one of 50 horsepower and the other of 75 horsepower. Owing to shipboard conditions no water vaporizer was used with either plant and the entire arrangement had to be such that there was absolutely no escape of gas into the machinery compartment. Notwithstanding the special nature of the equipment, an economy trial showed a consumption of only 1.13 pounds of coal per indicated horsepower. The producer will begin to furnish gas 30 minutes after starting a new fire, and the fire can be kept for months at a time and the engine started on 10 or 15 minutes' notice.

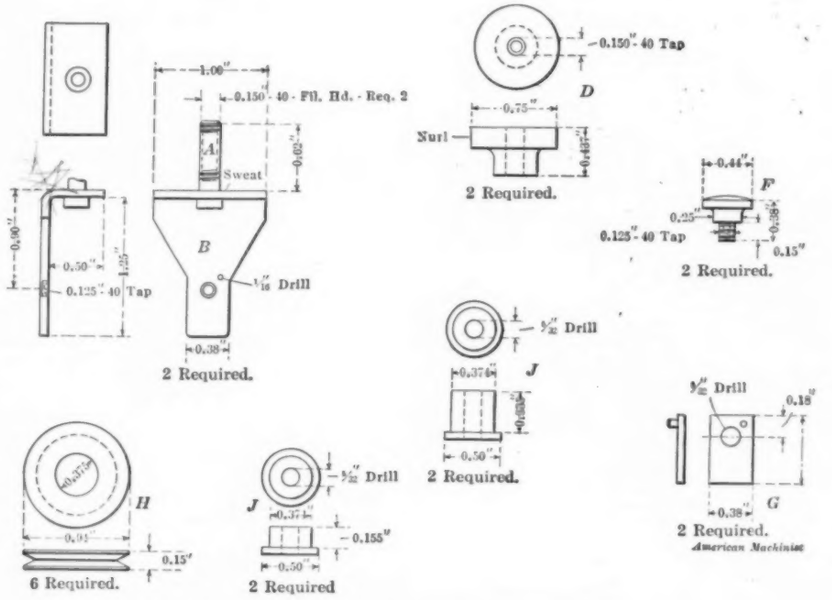


FIG. 2. DETAILS OF PARALLEL ATTACHMENT

Discussion of Previous Question

Letters from our readers showing how many men of many minds look upon various subjects opened up in previous numbers

Diameters of Shell Blanks

On page 931, Volume 33, Part 2, "Diameters of Shell Blanks," by C. P. MacArthur, is a formula which is incorrect and, as the subject is very important and liable to be read by many who would accept it without proof, I take this opportunity of pointing out its deficiency.

The formula referred to is:

$$m = \frac{h\,t}{T}.$$

where

m = Mean hight of finished shell;
h = Hight of finished shell;
t = Thickness of finished shell;
T = Thickness of metal before drawing.

The explanation accompanying it states that if we desire a shell 2 inches diameter by 6 inches high, and start with 0.040 inch metal, drawing it to a thickness of 0.020 inch, it will require a blank for a similar shell whose hight is 3 inches.

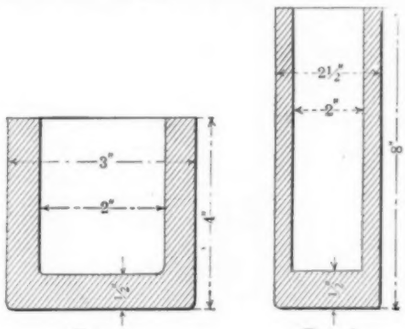


FIG. 1 FIG. 2

SHELLS, BEFORE AND AFTER DRAWING

We are reducing our metal thickness ½, but this does not necessarily mean that the hight will be affected proportionately; on the other hand, the hight is not affected in this ratio. For example, let us take a shell 2 inches inside diameter, 8 inches hight over all, metal ¼ inch thick, thickness of metal before drawing ½ inch and, according to Mr. MacArthur's formula, the mean hight would be

$$m = \frac{ht}{T} = 8 \times \tfrac{1}{4} \times 2 = 4 \textit{ inches}.$$

Fig. 1 is a sketch of shell 2 inches inside diameter × 4 inches high, metal ½ inch thick; we will now determine the cubic contents of metal in the shell:

Area of 3 inch circle =	7.0686 square inches
Area of 2 inch circle =	3.1416
Area of cylinder ring =	3.9270 square inches;
Multiplying by hight	4 inches;
Cubic contents of cylindrical ring	= 15.7080 cubic inches;

cubic contents of bottom = $3.1416 \times \frac{1}{2}$ = 1.5708 cubic inches; 15.7080 + 1.5708 = 17.2788 = total number of cubic inches of metal in shell.

Now let us consider Fig. 2, given herewith. This is a sketch of finished size of shell, with metal ¼-inch thick; except the bottom, which, of course, must be ½ inch, approximately, as the bottom will have practically no draw. We will compute contents of this shell as before:

Area of 2½ inch circle =	4.9087 sq.in.;
Area of 2 inch circle =	3.1416
Area of ring =	1.7671 sq.in.;
Multiplying by hight	8
Cubic contents of cylindrical ring =	14.1368 cu.in.;
Cubic contents of bottom =	1.5708
Cubic inches of metal in shell =	15.7076

Thus it can be seen we have 17.2788 cu.in. in Fig. 1 and 15.7076 cu.in. in Fig. 2

We have, therefore, 1.5712 cu.in.

more metal than required, which proves conclusively that there is something wrong with Mr. MacArthur's formula. Now, if we divide surplus metal by the area of circular ring, it will give us the additional hight we would have on our finished shell:

$$\frac{1.5712}{1.7671} = 0.889 \textit{ inch}.$$

Therefore, shell would be over ⅞ inch longer than required.

I have checked up the table given, for 15 or 20 shells and it corresponds with one I figured out a few years ago and which has been giving satisfaction.

Waterbury, Conn. J. L. MOORE.

Piercing Dies and Drill Jig for Brass Casting

Kindly permit me to criticize the article on page 933, Volume 33, Part 2, by T. H. Harris, relative to a couple of piercing dies for the typewriter casting.

Since the basic object in designing a set of jigs and fixtures is to secure accuracy of duplication and minimum cost, it would seem that while this method of punching out the hub and arm lugs on the casting in question may be as the writer says " somewhat unusual," it is not the best way to handle the work, for inasmuch as a drill jig is finally used to drill the holes *D* in the projecting arm on the hub, it would be much cheaper to make this jig accommodate the drill bushings for the other holes as well.

This could readily have been done by devoting a little thought to the matter. It should be obvious that the providing of two piercing dies, and a drill jig for one simple, little brass casting, together with the extra labor of setting, etc., is not modern practice.

Of course, there are sometimes extenuating circumstances that explain in part the "peculiar" methods employed in machining certain parts, but in this case I see no good reason for the piercing dies.

I would like to know where the disk which is punched out of the upper hub goes to, for it appears that the punch descends to the second flange and in this case there would be no escape for the above mentioned disk. There is no visible chance of escape shown in the drawing, and it is certain that the two holes are not punched separately, for the work would have no accuracy if such was the case, and besides we only have one finished surface to locate from.

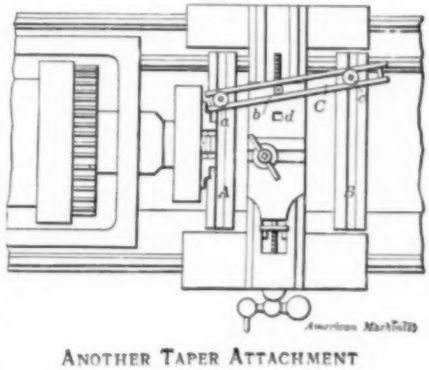
Regarding the drill jig, it is very bad practice to mount a piece in any jig so that the strain of machining is delivered against the clamping devices, as they always have a tendency to give.

The pressure should be taken by the solid metal of a resting pad or stud, whenever possible.

Detroit, Mich. ARON LAWRENCE.

A Makeshift Taper Attachment

I have read the article on "A Makeshift Taper Attachment," on page 883, Volume 33, Part. 2.



ANOTHER TAPER ATTACHMENT

While I do not doubt this attachment will give perfect satisfaction for the purpose named, cutting the taper on rivet and bur sets, it would give very poor service for most work, for two reasons: It does not produce uniform taper and on account of the relative lengths of the

lever arms the slide would have to be set at about 4 times the angle of the taper, or rather, *curve* produced.

The cut shows what I think is the best taper attachment when it comes to simplicity and accuracy. I do not mean that it is as handy as can be made, but it will do good work. It consists of two T-slots *A* and *B* clamped to the bed. As only a small part of this slot is ever used it could be made by drilling clear through and chipping. A *slot C*, which can be clamped across *A* and *B* in any position or angle, and a roller *b*, which turns on a stud tapped into the tool block and rolls in the slot. If the lathe has a compound rest, all that is necessary is to disconnect the nut from tool block by unscrewing the cap screw *d*. This arrangement cannot be used on a simple rest without having to tap the tool for adjustment.

Birmingham, Ala. JOHN A. COOK.

[The taper attachment shown on page 883 was called by its proper name, and was probably good enough for the work for which it was intended.—ED.]

Locating Holes Accurately in the Milling Machine

John Melville on page 692, Volume 33, Part 2, in discussing Mr. Murdock's indicator for the above purpose, describes the arbor and sleeve method of locating buttons on the miller; that he recognizes the drawbacks of that method, is apparent from his saying that given certain conditions (which seldom obtain) it is possible to work well within 0.001 inch. The cuts, Figs. 1 and 2, show a scheme by which buttons can be as accurately located on the miller as in the lathe.

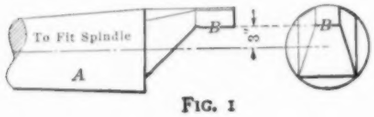


FIG. 1

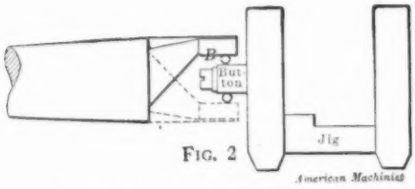


FIG. 2

LOCATING HOLES ACCURATELY

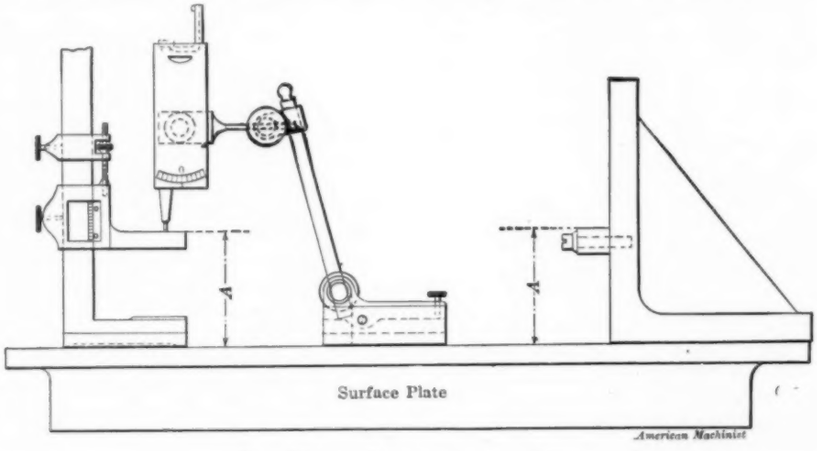
Fig. 1 shows two views of the setting arbor *A* of hardened steel, ground on the taper shank to fit the spindle hole and with its flat face *B* ground and lapped 0.3 inch off center; this lapping is not so much for accuracy as to give a smooth face for the gaging plugs described later.

Fig. 2 gives a view of the rig in use locating a jig button. The flat face *B* being 0.3 inch off center, and my buttons 0.4 inch diameter when the spindle and button are concentric a 0.1 inch diameter ground and lapped plug should just make contact with both the button and the face *B*, when the spindle is turned to any position. In practice, however, as the setting piece cannot be relied on to run perfectly true, about 10 extra plugs are needed, five varying by steps of 0.0002 inch larger and five smaller than 0.1 inch, the machine slides being adjusted until one plug "goes" and the next larger "not goes" between the button and the face *B* in any position the spindle being then set within 0.0001 inch.

Earlswood, England. GEO. E. GAY.

The Hight Gage and Accuracy

In answer to Mr. Melville's article on page 1022, Volume 33, Part 2, on the hight gage for accuracy, would suggest a way of setting buttons as practised in some of the best shops in the country. While the Prussian blue method is fairly good, it has its drawbacks, as the blue is apt to be put on thicker on one button, than on another. It is also a very slow way. The method I speak of is the test indicator in connection with the vernier hight gage. The method is as follows: Set the hight gage the required hight, and use an accurate test indicator with a surface gage as shown in the cut, and bring the contact point over the jaw of the hight gage and note the reading, then transfer the indicator over the button moving slowly over same and note reading at its highest point; the button can then be tapped up or down till the indicator reads the same as over the hight-gage jaw. The indicators I have in mind are made by Koch & Sons, and the dial test instruments, made by a number of firms in this country.



THE HIGHT GAGE AND ACCURACY

New Britain, Conn. C. BILLINGS.

Ball and Roller Bearings in the Line Shaft

On page 979, Volume 33, Part 2, the advocate of one type of roller bearing raises the point that "line shafting is generally subject to more or less bending, due to various loads and distances between supports," and therefore suggests the employment of a flexible roller that is supposed to conform at all times to the longitudinal curvature of the shaft. The basis for the suggestion may at once be assumed to be correct, although it is somewhat difficult to conceive. It may for the moment be granted that a flexible roller could accommodate itself to curvatures in the shaft, but it must be apparent that under such conditions there cannot be pure rolling; but there must be considerable grinding of the rollers in contact with the shaft.

As these rollers are also making contact with a decidely stiff box, which box certainly cannot follow the flexure of the shaft and the flexure of the rollers, it follows that there would be still more interference with pure rolling action, which means additional grinding and wear between rollers and box. It is this experience which led the various makers of roller bearings for lineshafting to the interposition of a sleeve between rollers and shaft; which sleeve, however, does not fully protect the shaft from grinding and wear, since the sleeve itself is more or less carried around the shaft.

The ball bearing of the single-row type possesses the very distinct advantage that all the balls lie in a single plane, at right angles to the shaft, and that, therefore the flexure of the shaft has no effect on the rolling action of the bearing. The only result of such flexure will be to somewhat increase the load that the bearing must sustain; the amount depending upon the force deflecting the shaft.

In a plain-bearing or a roller-bearing installation, allowing the shaft to get out of alinement has a serious effect in increasing the wear of the shaft, rollers and boxes, and also in increasing the friction losses, similar misalinement has no effect on the ball bearing; nevertheless, it is not good policy to allow a ball-bearing lineshaft to be misalined, because

the shaft in each revolution consumes power, and that power consumption is an absolute and preventable waste.

Philadelphia, Penn. HENRY HESS,
President Hess-Bright Manufacturing Company.

The Inefficiency of a Center Punch as a Precision Tool

Apropos an article on page 337, Volume 33, Part 2, Mr. Murdock describes and illustrates at length, a locating indicator for the miller, a device for locating jigs and other tool work on the milling-machine table in correct position for boring holes, each hole center being located from the center-punch mark, in which the point of the indicator is placed. The specification further states that the tool will save time, eliminate chances of error, and claims to supersede the button method on account of the ease of manipulation. Now it is obvious to me from practical shop experience, designing scores of jigs in all the multifarious shapes that must of necessity conform to the things to be jigged, that this tool is no substitute for the button method, nor can accuracy be the result of a tool of this description. I am amazed that the old center punch, which has stood so much abuse and so many punchings, should be raised from its degraded position to one of dignity and good standing. In the first place who will swear by a mark made with a center punch, and when made who will test it? It seems to me that you will be obliged to take a lot for granted, and also keep your micrometers and vernier gages locked up in your kit, when the foundation of your energies have been made from a center-punch indention. Where does the center punch gain such esteem that an elaborate tool needs to be made to aline its work with milling-machine spindle? I take it that to a toolmaker an indention made by a center punch, or a line scratched by a hight gage are only the preliminary details that lie behind the vernier and micrometer caliper. The meeting of a line with another one drawn at right angles is an unknown location on metal, as it is on the draftsman's paper, and anything that depends upon the discretion of a person behind a center punch, leaves much to be desired. The beauty of the button system is that it is no experiment. It is not left to blind chance, but if work is set out correctly with the use of precision tools, there is no doubt about conclusions. I have tried both methods, and I have no hesitation in swearing allegiance to the button system. A center punch is a crude tool indeed, at its best, and no amount of care or logic can make a precision tool of it.

ERNEST METCALF.
Otley, Yorkshire, Eng.

The Profession of Teaching Again

Just now it appears to be about the proper time to swat Entropy for his alleged confession.

Professor Higbee, at page 1030, Volume 33, Part 2, makes a stab at him that must have made him shrink into his boots—until he read it the second time. For fear that the editor may be tempted to bar Entropy from his columns or for fear that the latter's well known bashfulness may influence him to hide till the storm blows over, I venture to hold out the olive branch of peace. If the branch should fall and the sharp end happens to hit someone, he shall have my heart-felt sympathy, but nothing more.

This controversy is as old as the memory of the oldest living inhabitant. For years and years men in the active and nonprofessional industries have writhed in pain to see the professional classes living on what they knew and not on what they did. The mechanic who had won his spurs by years of hard knocks and whose education by that process was as thorough and as dearly bought as the lawyer's, saw himself compelled to accept money only as he earned it by what he did. He might design a new machine that reduced the cost of a process 99 per cent., but he could not collect from the public anything but the profit on the manufacture of the machine. On the other hand, he saw the lawyer collecting large fees for advice, corresponding to his design, without having to manufacture anything and hardly having to even prove that his advice was sound. And yet all the lawyer could say in his own behalf was that *he* had spent much time in learning his profession.

The same feeling on the part of the layman has prevailed toward all professions. Only recently has the mechanic, the manufacturer, the merchant, begun to assert himself. Not that he sneers at education, not in the least, but he refuses longer to see one class, self-immolated from what he calls work, assert its supremacy over the "greasy mechanic" and the "dollar-hunting tradesman."

Entropy asks that half the professors be set to work at manual labor and the other half be given a wage on which it can live and duties commensurate with the wage.

Mr. Higbee tangles himself up to the extent of admitting that the profession contains men who could profitably be weeded out if larger wages could be had. On the other hand, having discovered another hank of rope he gasps with a final splutter that the men who are capable of earning $3000 to $4000 a year in commercial life leave the colleges and "the profession of teaching gains thereby."

Now, in conclusion, I wish to say that I do not believe that Entropy or one layman in a hundred sneers at education. I do believe that thousands of intelligent, educated American people are beginning to feel that there is a tremendous economic waste somewhere in the system of education; whether in the lower schools or in the higher or both we do not know, but this we do feel that if everything is right with the schools they will bear stirring up, and if anything is wrong, they need it.

Fitchburg, Mass. CON WISE.

Homemade Things

Mr. Godfrey cites several examples to prove that it does not pay to make shop tools and devices in the shop where they are to be used, or more specifically by a shop devoted to other work.

While it must be admitted that great discriminatiion and good judgment are necessary in deciding as to what can and cannot be profitably "home made," with the equipment and men at hand, let us not go too far with the notion, lest we get the idea that it would be cheaper after all to let the other fellow do all of our work for us.

In a shop where the overhead expenses were high, the equipment good but not extensive, and the wages paid were average, we used to make face mills, standard end mills, special screw-shank end mills, counterbores, reamers and other tool-room equipment. A carefully kept record of costs showed a saving of almost 50 per cent. in some cases, while it showed a loss in others; there is where your good judgment comes in. Then, too, there are advantages in making certain things oneself, the design and proportions may be changed to meet some special requirements of the shop or work in hand. When the shop is a little "dull," why not keep the good men by letting them make up tools and shop devices for the brighter days ahead?

Indianapolis, Ind. F. B. H.

According to a consular report a new process of galvanizing, claimed by experts to be most practical and scientific, has been invented by a Zurich chemical engineer. The method consists in distributing pulverized and melted metal over the surface of any article by means of a special apparatus, which ejects the solution with such force that the minute particles of the reduced metal adhere in the form of a solid coating that possesses a remarkable homogeneity and appearance. The process may be applied not only to metals of various kinds, but also to plaster, glass, celluloid, wood, or paper. The metallic composition may be of tin, lead, copper, or aluminum, and even gold and silver may be utilized for certain purposes.

The Gear Hobbing Machine-Finish

By Geo. B. Grant *

Not the end of the matter by any means but only the "finish" or smoothness, or generally roughness, of the surface of a hobbed gear tooth.

While the various advocates of the gear-hobbing process are settling their very conspicuous differences and coming to an agreement as to whether there are flats or no flats on the surface of the hobbed gear tooth, and as to whether the flats should be ground off with an emery wheel, or cut off by running an ordinary cutter over the work, or left to rub off in use, we may take up another feature of the hobbed tooth and try to find out why it looks as if it had been finished with a wood rasp whenever the hob is driven into the work with a coarse feed in the desperate effort to keep it up to its promised output.

The surface of the hobbed gear tooth may be rough from three separate and quite different causes: the flats, due to the theory of the process and unavoidable; the chatter marks, due to the impossibility of designing a machine strong enough to stand the strain of the tremendous and intermittent action of the hob when driven hard into the work, and the natural ridges and hollows left by any milling cutter with straight teeth.

We will here ignore the flats, assume that the machine is strong enough to prevent chattering, and consider only the roughness due to the natural action of the milling cutter, a matter that is entirely in the control of the workman and dependent mostly on the rate of feed of the cutter as a whole.

The feed of the cutter is uniform but its teeth act intermittently, each one leaving a ridge and a hollow as it passes the lowest point of the cut, and the number of these ridges in an inch may be taken as the measure of the roughness of the milled surface. If the cutter has ten teeth and the feed is a tenth of an inch per revolution it will make 100 ridges to each inch and the surface will be of "100 mill finish" to coin a term. If one surface has 100 ridges to the inch, and another has 200 ridges in the same distance, then the latter surface is twice as smooth as the former.

Consider a common disk-gear cutter with 10 teeth, and assume that it has been properly sharpened so that all the teeth are of the same length and leave equal marks on the work. Suppose it to revolve ten times while the feed of the cutter as a whole is one inch, then it will make 10 × 10 ridges to the inch and the finish will be 100 mill finish.

Now, consider a hob having any number of gashes or rows of teeth and give it a feed as a whole of a tenth of an inch per revolution, what will be the resulting degree of finish? The hob must be considered as a series of fly cutters, each one acting for itself but all arranged in a spiral so that the series of cuts or "flats" made by them one after the other combine to form a surface approximating more or less to the involute-tooth surface. Each fly cutter acts on one and only one part of the tooth. The central cutter, the one used to center the hob, cuts the bottom of the tooth space and the lowest flat on each side of it, the cutter that makes the flat at the pitch line acts at no other place except to remove stock out of the way and so on. Each fly cutter will leave a ridge on the work every time it passes the finishing position, that is, once for each revolution of the hob, and the finish will depend on the feed of the hob as a whole, while the whole gear being cut makes one revolution. If the hob is fed a tenth of an inch per revolution of the whole gear, it will leave a "10 mill finish," one finishing touch every time it comes around to the same tooth.

"Any hob, no matter what its number of gashes may be, must either run 10 times as fast as a disk cutter having 10 teeth or take 10 times as long to cut the same length of finished work, if the degree of finish is required to be the same."

*President, Philadelphia Gear Works.

Comparison of Work of Disk Cutter and Hob

Put it another way. A disk cutter has 10 teeth and a feed of a tenth of an inch per revolution, giving 100 finish, and it cuts a gear of 30 teeth. It will make 30 times 10 revolutions, or 300 revolutions, to finish one inch of the face of the whole gear to a smoothness of 100. A hob has any number of gashes or rows of teeth and is fed a tenth of an inch for each full revolution of the gear of 30 teeth, or 10 times 30 revoultions to finish one inch of the face of the whole gear to a smoothness of 10. That is, if the hob and the ten-toothed disk cutter make the same number of revolutions, 300 in this case, to finish the same distance, one inch, of the whole gear, then the hob-cut surface will be 10 times as rough as the disk-cut surface.

Put it this way. If a hob cutter and a disk cutter revolve at the same speed and cut the same length of gears of equal numbers of teeth, and give the same degree of finish or number of ridges to the inch, then the hob must make as many revolutions as the disk cutter makes multiplied by the number of teeth in the disk cutter.

Any hob, no matter what its number of gashes may be, must either run 10 times as fast as a disk cutter having 10 teeth, or take 10 times as long to cut the same length of finished work, if the degree of finish is required to be the same. This appears to be the true explanation of the roughness of hobbed gear teeth as compared with disk-cut gear teeth. The short and ultimate reason is that each one of the teeth of the disk cutter acts to finish the whole outline or form of the tooth space, while each tooth of the hob cuts only a small part of a single section of the tooth space.

The action of the hob is generative and linear, following the linear outline of the tooth section, and, so far as the finish is concerned, it is in action always at a single point. The action of the disk cutter, on the contrary, is not generative and is not linear. The whole outline of the tooth section is finished at one instant by a cutting edge acting along a whole line rather than running along that line by points.

We have assumed that the cutters are perfect in form and properly sharpened, conditions rarely realized, but, when we consider imperfections of an arbitrary nature we have to deal with all sorts of roughness.

In a paper dealing with the steam turbine versus reciprocating engines presented before the annual meeting of the Society of Naval Architects and Marine Engineers, comparative results in steam and coal consumption with turbines, reciprocating engines and a combination of the two were given. A triple screw, 1300-ton steam yacht had been fitted with steam turbines which, on trial, failed to fill the guarantee of the makers as to economy, and it was decided to substitute a triple-expansion engine for the middle-screw turbine, the engine to exhaust into the remaining turbines. With the three turbines 34 tons of coal were required to produce 13 knots over the trial course. With the triple-expansion engine alone this consumption was reduced to 25 tons and to 22.7 tons with the combination of engine and two exhaust turbines.

Issued Weekly by the
Hill Publishing Company
JOHN A. HILL, Pres. and Treas. ROB'T MCKEAN, Sec'y.
505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

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Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E.C., will serve all subscriptions for English Edition for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Published in the German language under the name of "Maschinenbau," by the Hill Publishing Co., m. b. H., 71 Unter den Linden, Berlin, N. W. 7. Price for Germany 24 M., Austria 29 K., Switzerland 32 Fr., other countries in Eastern Hemisphere 35 M., North or South America 40 M., or $10.

Entered at New York Post Office as mail matter of the second class.
Cable Address, "MACHINIST," N. Y.

CIRCULATION STATEMENT

During 1910, 1,488,400 *copies. For December,* 1910 *(American weekly, American monthly, English weekly and German weekly), total,* 149,750.

January 5..... 41,750
January 12..... 27,500

None sent free regularly, no returns from news companies, no back numbers.

Contents

PAGE

Molding Air-cooled Cylinders..... 49
Browning Damascus Gun Barrels..... 50
Remarkable Tool Steel Castings..... 51
Cutting Turbine Reduction Gears..... 52
Forming Screw Conveyer Flights..... 53
Economical Machine Design..... 54
Speed Chart for Automobiles..... 54
Cutting Plate Cams on Milling Machine.. 55
Obtaining Patent Specifications..... 59
Expense Accounts and Analysis..... 60
Friction Clutch for Machine Tools..... 64
An Employee's Daily Report Card..... 66
Checking Pyrometers in Service..... 67
The Differential Piece Rate..... 68
National Museum of Art and Industry... 69
Letters from Practical Men:
A Pneumatic Milling Fixture....Removing Blots from Tracing Cloth....A Method of Soldering Parts by Dipping....Method of Imparting a Gun Metal Finish to Aluminum and Die Cast Parts....Correcting Wrongly Drilled Holes....A Micrometer Surface Gage....More Draftsman's Kinks....Adjustable Holder for Thread Cutter....Hardening Thin Edge Tools....Tool Steel Economy....Parallel Attachment for Drawing Board.....71-74
Discussion of Previous Question:
Diameters of Shell Blanks....Piercing Dies and Drill Jig for Brass Casting....A Makeshift Taper Attachment....Locating Holes Accurately in the Milling Machine....The Hight Gage and Accuracy....Ball and Roller Bearings in the Line Shaft....The Inefficiency of a Center Punch as a Precision Tool....The Profession of Teaching Again....Homemade Things....75-77
The Gear Hobbing Machine Finish..... 78
Our National Museum of Art and Industry 79
Rules Governing Oxy Acetylene Apparatus 79
Compensation for Accidents..... 80
The Foreman's Voice..... 80
Shop Equipment News..... 81
Die for Car Sill Brace..... 83
Coöperation of Salesmen and Factory.... 84
Lubrication of Ballbearings..... 87

American Machinist

Our National Museum of Art and Industry

In another column we print an important article dealing with the work of the Smithsonian Institution at Washington in founding and developing an American National Museum of Art and Industry.

The proposal for such a museum is by no means new, and, in fact, has been a part of the program of the Smithsonian Institution from its earliest days. Failure on the part of succeeding Congresses to appropriate funds for museum purposes has been the only factor which has retarded its realization. However, with the completing of the new splendid building in Smithsonian park, to be known as a Museum of Natural History, the space is made available in the older building of the National Museum for the establishing of a real museum of American arts and industries. The officials of the Smithsonian Institution have worked out a broad plan which contemplates a museum of this kind within the walls of the old building, with perhaps a thought that after Congress sees what can be done with the resources now available, another new building may be added to the existing museum buildings, suitable and fitting as a home for the historical records and priceless objects which will tell the story of the inception, growth and present status of every important industry.

Turning now to a restricted field, that of machinery, we urge upon individuals and firms having important historical matter dealing with the early days of machinery building that they offer these things to the National Museum. What a priceless treasure is the first machine tool of a revolutionary type? Only a few such types have ever been developed, and it is probable that a much smaller number of first machines can be found. For this reason, they are of yet the more value. The textile-machinery field has a splendid history, which might be made available, and it is a source of gratification to know that in the shoe-machinery field much has already been done by the United Shoe Machinery Company to preserve early models of important machines and devices.

During the past three years we have published numerous articles dealing with early machine tools. These we have referred to rather loosely as historical articles. From the fact that we were able to find the material upon which to base them, we are led to believe that there are many more important machines and valuable records in existence than one might believe from a hasty consideration of the subject. Now, the opportunity is presented for gathering these objects together, letting them fit into their proper places in historical sequence, as one part of the forthcoming National Museum of Art and Industry.

We urge all who have historical material of this kind to consider it a patriotic duty to offer it to this museum.

Rules Governing Oxy-Acetylene Apparatus

The large increase in the number of shops that are using the oxy-acetylene welding apparatus for manufacturing and repairing their various products, has caused the National Board of Fire Underwriters to recognize this industry and pass a set of rules and requirements for the safeguarding of the apparatus and the property on which it is located. This has been due largely to the fact that a number of accidents of a more or less serious nature have occurred in the recent past. These in turn have been due to the fact that the industry is a new one, and the design of the apparatus has not always been that most conducive to safety.

When the apparatus is properly designed, and the necessary safeguards used, there is little more danger in handling the oxygen and acetylene gases than there is in handling the illuminating gas or electricity with which shops are lighted, or the kerosene oil which has been so largely used in the past. Without the proper knowledge of these gases, however, and the necessary apparatus for their use, they become very dangerous elements.

The rules and regulations that have been laid down for the construction and installation of the apparatus, the control and use of the gases for heating and welding purposes, are printed in a 3½x5½-inch booklet of 30 pages, and we would strongly advise those who have welding apparatus of this kind, or those who are contemplating putting it in, to send to the National Board of Fire Underwriters, New York, for one of these booklets. The rules cover the construction of the apparatus in every essential detail, from the foundation to the torch that applies the heat to the work.

These rules are simple in their nature and easily applied at small cost to any apparatus that may be in use. It will enable those who are contemplating putting in apparatus of this kind, to see that the builder has complied with the neces-

sary rules. When they have been compiled with, there will be little danger of loss of life from explosions, or of losses by fire, as they place practical safeguards around the apparatus that enable it to be safely used when the ordinary amount of care is exercised.

Compensation for Accidents

The need of suitable plans for compensation for workmen killed or injured in any industry is once more brought to mind by a recent accident in New York City, where a grinding wheel burst, owing to a piece of iron jarring from an overhead shelf, and becoming wedged between the wheel and the rest. There is little use in attempting to attach blame to either party, but the fact remains that there is an economic loss to the community in general, and the family in particular, and it is obviously unfair that almost the entire loss should be borne by the latter.

Probably the most satisfactory compensation from all points of view is the payment of the victim's wages for a sufficient period. But such a procedure might easily bankrupt a small concern if borne alone, so that it becomes evident that such burdens must be distributed over the whole industry in some such manner as the fire risk is provided for. The question of details can be discussed at any desired length, but it must be obvious that some provision of this kind is necessary for the employer, the employee and the community.

The Foreman's Voice

A peculiar suit for damages has been threatened if not actually instituted, against a manufacturer in New York State. The claimant is a former employee, whose nerves, or hearing has been injured by the unpleasant tones used by his foreman in conveying orders concerning the work and in otherwise disturbing the peace and quiet of the paper mill in which he was employed.

In language which is more legal than concise, the complainant estimates his injury at a thousand dollars. While we have heard of voices of opera singers being worth unheard sums of money, this seems to be the first case on record where the voice has had such damaging and disastrous effect as to be estimated in an exact sum for damages.

In spite of the absurdity of such a claim, there may be a germ of truth in the statement that some few foremen are unnecessarily noisy and that their loud and unpleasant voices have a bad effect on the men. While voice culture is hardly likely to become part of a foreman's training, it is often true that a well modulated voice carries more weight than the loud, blustering eruption of words which occasionally greets our ears.

There may be classes of men who require this kind of a foreman, but they are not or should not be in a modern machine shop. Some of the most effective executives have rather low voices, but they carry weight and conviction much more than mere noise and bluster, as well as having a better effect on their subordinates.

This is one of the problems that each foreman must work out for himself, for, unless he is so noisy as to be a shop nuisance or so disagreeable as to affect the men badly, no employer is likely to demand specially trained voices as long as the work is satisfactory.

New Publications

Hendrick's Commercial Register. 1344 6x9-inch pages. S. E. Hendricks Company, 74 Lafayette street, New York City. Price, $10.

This nineteenth annual edition of Hendrick's Commercial Register of the United States for Buyers and Sellers is by far the most complete edition that has thus far been published. The preceding edition required 87 pages to index its contents. This edition requires 100 pages, or 13 more. The total number of classifications reaches 35,481, each representing some machine, tool, specialty, or material required in the architectural, engineering, mechanical, electrical, railroad and kindred industries. There are 124 additional pages, compared with the eighteenth edition, and, as 114 pages of former matter were omitted, there are, in all, 238 pages entirely new. The whole represents upward of 350,000 names and addresses. The work is so well and favorably known that we hardly need mention its field of usefulness. It is so arranged that it can be used for both purchasing and mailing purposes. Thus, it is of equal value to the purchasing department and the sales department. To illustrate, the first classification is of all manufactures of a particular trade under general headings for mailing purposes, then, there is a subdivision for each firm or corporation under as many classifications as the variety of products calls for.

Personals*

Ethan Viall joins the staff of the American Machinist on January 16, as associate editor.

John Bath, president of the Bath Grinder Company, Fitchburg, Mass., has returned after a several weeks' business trip abroad.

Marcus A. Coolidge, president of the Fitchburg Machine Company, Fitchburg, Mass., has returned from a several weeks' business trip in Europe.

*Items for this column are solicited.

E. F. Lake, for several years associate editor of the American Machinist, has resigned to go into other lines of work. He carries with him the best wishes of all his former associates.

D. W. Call, formerly assistant to the president of the American Steel Foundries Company, has been elected president of the Allis-Chalmers Company, to succeed W. H. Whiteside, recently resigned.

L. J. Hoover, who was formerly general manager of the Grant & Hoover Ball Company, of Merchantville, N. J., has connected himself with the sales department of the Grant & Wood Manufacturing Company, Chelsea, Mich.

William L. Schellenbach has resigned as manager of the machine-tool department of the John B. Morris Foundry Company, Cincinnati, Ohio, to accept the position of mechanical engineer with the Lodge & Shipley Tool Company.

H. L. Beeler, for some time advertising manager of the Le Blond Machine Tool Company, Cincinnati, O., has resigned in order to assume the position of general manager of the John B. Morris Machine Tool Company, of the same city.

Gustavus C. Henning

Gustavus C. Henning, who was well known to many of our readers, died at his home in this city December 30.

Mr. Henning was born in Brooklyn in 1855 and was educated at the Brooklyn Polytechnic and the Stevens Institute of Technology, from which latter institution he was graduated in 1876. Shortly after his graduation he was made inspector of materials for the Brooklyn Bridge, which was then in process of erection. After the completion of the bridge he made the inspection of materials a specialty and invented several pieces of testing apparatus. In 1898 he began the translation from the German of Professor Martens' monumental work on "Testing Materials of Construction," which was subsequently published and duly noticed in these columns. As his friends well know, he had been in failing health for some years, and it is to overwork on the translation of Professor Martens' book that his original breakdown is charged.

Mr. Henning was a member of many leading engineering and technical societies, both American and foreign, and among the latter the International Association for Testing Materials of Construction. The success of this society abroad, as shown during his attendance at its meetings, led him to agitate for the organization of the American society, which was ultimately brought about largely through his efforts. He joined the American Society of Mechanical Engineers during its first year—1880—and was a member of the Council for the term 1896-99.

Shop Equipment News

ANY and all new or improved machines, tools or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here — the machine shop news.
A more full and detailed description will be given — when it is real news — if it can appear here first — before it is sent to other papers. ALL descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German

A Pistol Rifling Machine

The pistol rifling machine shown herewith has recently been developed by the Pratt & Whitney Company, Hartford, Conn.

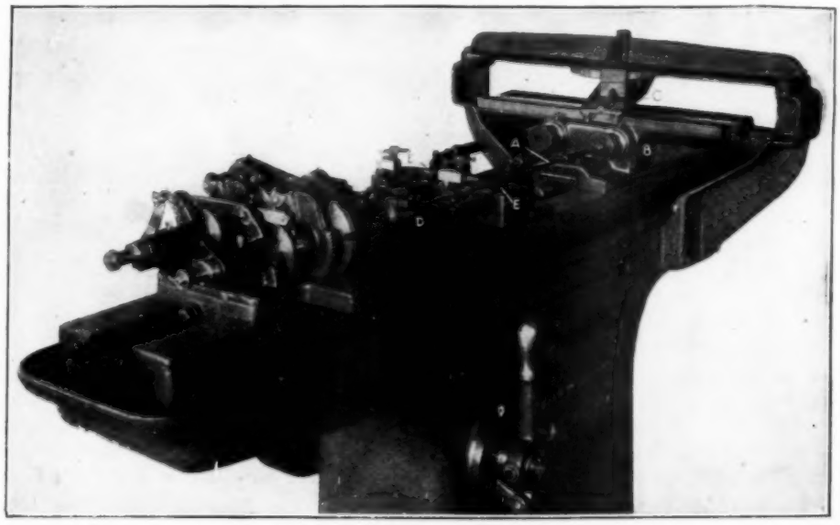
This machine will accommodate any style of pistol barrels up to ten inches in length. It is entirely automatic in operation, and after once setting requires but little attention other than supplying the necessary work. The machine is made so as to operate upon two pistol barrels simultaneously, which greatly augments its production capacity.

Care has been exercised to make the various operating mechanisms as simple as possible, also to locate them in the most accessible manner in order to afford convenience in operation.

The two spindles which carry the rifling rods *A* are mounted in the head *B* which travels longitudinally on the bed. The rotating action of the spindles by means of which the required lead to the rifling groove is obtained is governed through a taper bar *C* in the same manner as on the regular well known Pratt & Whitney rifling machines. By the swiveling of this bar any desired lead is obtainable.

The traveling action of the head is under very accurate and positive control, any desired length of stroke being readily obtainable. It is also provided with an exceedingly rapid quick return which reduces the non-cutting time on the return stroke to the minimum. A three-grade cone is provided by means of which the speed of the head may be varied as required. The machine may be instantly stopped independent of the countershaft by means of a conveniently located lever at the front of the machine; this is found very convenient, as considerable time is saved in inserting new work.

The indexing mechanism to which the work holders *D* are attached is very compact in design and entirely automatic in operation. It is made a complete unit and may be adjusted to any position on the bed to afford convenience in operation. This mechanism is regularly made so as to index for either 4, 5 or 6 grooves as desired.



A Pistol-rifling Machine

The work-holding appliances may be varied according to the nature of the work. They are designed to permit the insertion of work with ease and accuracy.

The hook cutter type of rifling tools used are very substantial and rapid in operation. The cutter is automatically fed and withdrawn for each succeeding cut until the required depth has been obtained, when it automatically stops feeding. A unique cutter-cleaning device *E* is also provided by means of which chip interference is entirely eliminated. It consists of a rotary brush.

The oiling arrangements are very complete, each machine being provided with an oil pump, tank and suitable piping. The spacious oil pan, which is cast integral with the upper portion of the column, perfectly controls the used oil- conveying it to the large oil tank conveniently located in the bed.

Outerbridge Silicon Alloy

This alloy is calculated to make gray-iron castings softer, stronger, cleaner and more homogeneous, and to reduce shrinkage, cracking and blow holes.

In using this alloy the iron can be poured at a greater distance from the cupola, and it controls the character of the iron drawn therefrom, and moreover enables one to vary the grade of iron in individual ladles to suit special castings. Its action is to drive the dirt and slag to the top, where it can be skimmed off.

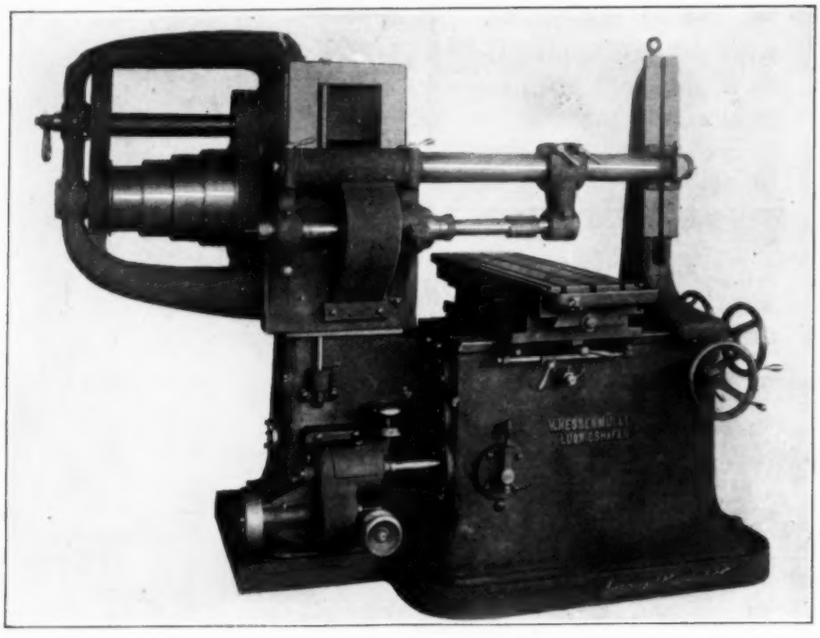
It is only necessary to drop a small quantity of the finely ground alloy on the bottom of the ladle before tapping in the proportion of one pound to four or five pounds of iron, and then skim the ladle and pour as usual. This alloy is particularly suitable for iron running less than 3 per cent. silicon, as more scrap can be used.

The J. W. Paxson Company, Philadelphia, Penn., has completed arrangements with A. E. Outerbridge, the inventor, for the sale of this product.

A German Horizontal Milling Machine

The bed is cast in one piece, hence all strains due to the weight of the work and to the pressure of the cut are taken by the foundation. Instead of the knee the spindle head is provided with a vertical hand feed. The drive is of the cone-pulley and back-gear type, but an all gear speed box can be provided without altering the design. The cone pulley and the

back gears are supported between two bearings and drive the milling spindle through 3 large swinging gears which allow the head to be elevated 16 inches over the table by means of the handwheel at the right side of the machine. The milling spindle, of 3½ inches diameter and runs in bronze bearings, adjustable for wear. The bearings are provided with an arrangement for continuous oiling.



A German Horizontal Miller

The outer bearing for the arbor, slides on a steel bar which is supported by a column at the right. The feed box at the lower left-hand corner of the bed is driven by the countershaft. The feeds are changed by sliding keys and the handwheels shown. The feed is marked on the disks beneath the handwheels.

Nine feeds are provided, from ¾ to 12 inches per minute, in geomertical progression, and 16 spindle speeds, from 10 to 350 per minute, also in geometrical progression. The countershaft has two speeds.

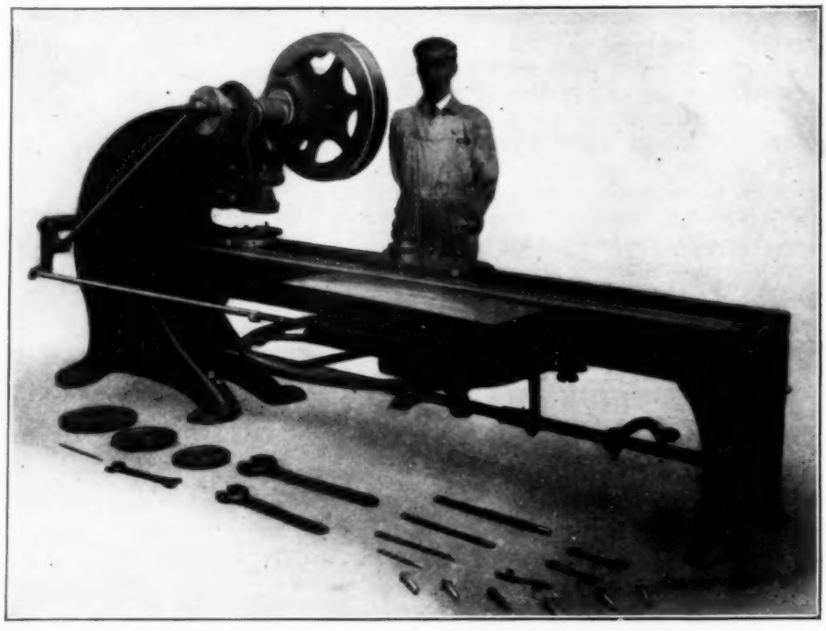
Length of the table 45 inches, width 15 inches. Longitudinal traverse 36 inches, cross traverse 15 inches. Weight 6000 pounds. The oil pan is a separate casting and screwed to the bed. It is built by H. Hessenmüller, Ludwigshafen, Germany.

A Special Press for Notching Armature Disks

The halftone shows a type C 94 press built by the Ferracute Machine Company, Bridgeton, N. J., designed for notching the larger sizes of armature disks.

The indexing mechanism is operated from the crank shaft through the medium of the bell crank, shown at the side. The connection from this crank to the pawl lever is by means of a telescopic pitman made of bicycle tubing so that it can be adjusted to the different positions of the saddle (carrying the vertical indexing spindle) required by the varying sizes of disks. On the lower end of the indexing spindle is placed a very large gear wheel, into which engages the pinion on the same shaft with the ratchets. Various ratchets are supplied, and they can be very quickly changed when required, although a given disk will give considerable range of indexing by varying the number of notches taken at a stroke. On the large gear is a tappet, which, when the wheel has made one revolution, throws out the clutch and stops the machine, and when the wheel has been moved for a notch, a brake, operated by the same connection to the crank shaft, prevents the gear from going beyond its proper position, or overrunning when moving fast, and holds it still while the punch is descending; this brake enables the machine to be operated at a higher rate of speed than would be possible without it, up to 200 strokes on the smaller disks. The die bed is adjustable vertically so that the die can always be set at the right hight, and the depth of the notches can be accurately secured by means of the screw movement of the saddle upon the bed.

There are three sizes of presses in this series. Press C 92 notches disks up to 48 inches diameter; press C 93 up to 84 inches; and press C 94, the one illustrated above, up to 120 inches in diameter.



A Special Press for Notching Armature Disks

A Pulley Dressing

A new pulley dressing is being put on the market by Arthur P. Smith, Brooklyn Warehouse and Storage Company's building, Brooklyn, N. Y.

The dressing is in the form of a paste which is applied to wood or metal pulleys by means of a brush. It sets in about six hours and is then ready for business. It is claimed for this dressing, that it prevents slippage of belts even in an atmosphere saturated with steam, and that heat, cold, dust, or oil vapors have no effect on it. It is known by the trade name, Smith's Bull Dog Pulley Dressing.

Die for Steel Car Center Sill Brace

By S. H. Hurley

Dies made of gray cast iron, with hard steel "wear irons" in the corners to take the heavy abrasion at these points.

As the work is pressed hot, not only must proper clearance be allowed, but the die size must be such that the ultimate shrinkage of the piece when cool will bring it to the exact dimensions required to fit into the car structure.

In the manufacture of steel freight and passenger cars a large amount of pressed-steel material is used, and the method employed in pressing the flat-steel plates into the desired shapes is rather interesting. A good opportunity for originality is afforded by this line of engineering because a great variety of shapes are used, and consequently all kinds of schemes must be employed in order to get out the finished product at the least possible cost. The steel is pressed in dies by hydraulic presses ranging in capacities from 50 to 1000 tons, the press used depending upon the weight of the material worked. The dies are practically all made of ordinary gray cast iron and are comparatively heavy in order to withstand the compressive stress upon them. Extreme accuracy as well as good judgment must be exercised in their design, for not only must the exact size and shape of the finished piece be taken into account, but the shrinkage of the material as well as clearance must be allowed for when it is pressed hot. The accompanying illustrations show dies for pressing one of the ordinary shapes which is found in nearly every steel freight car.

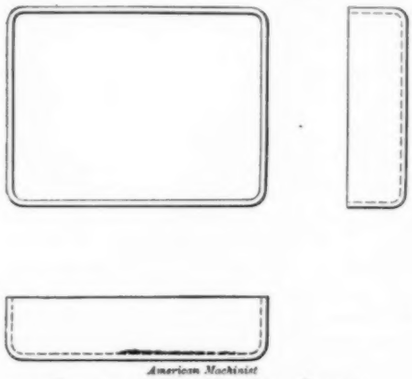


FIG. 1. A CENTER SILL BRACE

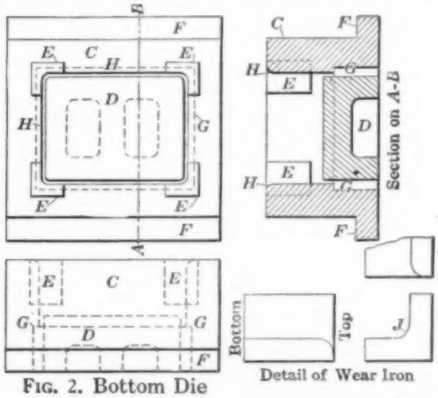


FIG. 2. BOTTOM DIE

Detail of Wear Iron

DIE DETAILS

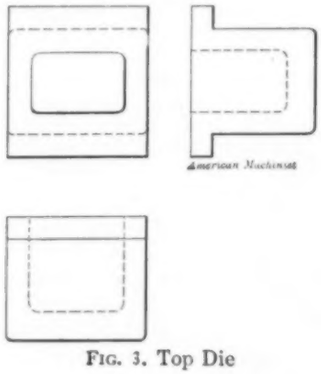


FIG. 3. Top Die

Fig. 1 is a center sill brace, 10x13x3 in. deep, outside dimensions, and made of ¼-in steel plate. This form of brace is used on cars having double center sills and is riveted between the sills, where it serves as a stiffener. It is shaped in a 250- or 500-ton press and must be pressed hot in order to properly form the closed corners.

Fig. 2 is the bottom die and consists of the main casting *C*, the false bottom *D* and the "wear irons" *E*. The main casting is about 10 inches high and the false bottom half that, thus making the die 5 inches deep. This is the usual depth used for pressing a brace or diaphragm which is from 2 to 4 inches deep. Approximately ⅛ of an inch per foot is allowed for shrinkage on this kind of work, so the inside of the main casting is 13⅛ inches long and 10⅛ inches wide. The four inside corners are notched out in order to receive the "wear irons." Below the "wear irons" the corners are filleted with a radius equal to the outside radius of the finished piece. The sides are made about 3 inches thick, and along two of them, flanges *F*, 2 inches square, are cast, by means of which the die is fastened to the press. On the inside, about one inch below the top of the false bottom, there is an offset *G*, ½ inch deep, which is put in to save finishing. The main casting is finished top and bottom, and on the inside down to the offset. The top inside edge *H* is rounded off all the way around by about a ½-inch radius. The "wear irons" *E*, of which a detail is shown in Fig. 2, are made of hard steel and are used to protect the corners of the die. They are about 1 inch thick, 3 inches long on each leg, and 4 inches deep. The inside corner *J* is filleted with a radius equal to the outside radius of the finished piece, and the top is rounded off the same as the main casting. They are finished all over and held in place by a driving fit. The false bottom *D* is a separate casting and sets down inside the main casting with a clearance of about ⅛ inch all around. It is cored out in order to lighten it, leaving about 2 inches of metal on the sides and from 2½ to 3 inches on top. A 2-inch web is cast in the middle, more for the purpose of giving a bearing surface for the ram than for reasons of strength.

The top die shown in Fig. 3 is of simpler construction than the bottom die and consists of one casting. A clearance of 1/16 inch is allowed all around, between the plate and the top die, so that it can be lifted out of the finished piece after the operation is completed. The clearance is allowed on this die because the metal will flatten out and take the size of the other die. This makes the dimensions 5/16 inch less all around than those of the bottom die, so that the top die is 12½ inches long and 9½ inches wide, with a 2-inch flange cast along two sides at the top by means of which it is clamped to the press. The hight of this die is 11 inches, making the total hight of the dies when brought together 16 inches. This dimension, of course, depends upon the press used, but for a capacity of 250 or 500 tons, it should not be any less, because this is about as close as the press can conveniently be brought together. The corners are rounded off with a radius 1/16 inch less than the inside radius of the finished piece, thus allowing for clearance. The die is finished on top and bottom and sides, and is cored out as shown, leaving 2 inches of metal all around and from 2½ to 3 inches on the bottom.

The operation of pressing the shape is as follows: The dies are clamped to the press and accurately lined up. The stock, which is a flat plate 15x18x¼ inch thick, is laid upon the bottom die. The top die is brought down and presses the hot metal down against the false bottom, turning up the sides and forming the

closed corners. Then the ram is brought up against the false bottom and as the top die is lifted up, the false bottom follows it, being raised by the ram. The finished piece is thus lifted out of the die by the false bottom. Then the ram is lowered, the false bottom drops back into place and is ready for the next operation.

Cooperation of Salesmen and Factory

By Arthur Greene *

A manufacturing business is dependent upon the production and sale of goods. Both the sales department and factory must get together if the best results are to be obtained.

*Systematizer and production superintendent.

Every manufacturing business is begun with the making of the goods and is carried on by the sale of them. No man would think of starting out to manufacture without making some preparation for the sale of the product, and no man would make preparations for the sale of a product without preparing also for its manufacture. The factory organization will go out of existence without a sales organization, and the sales organization could not exist without the factory organization. The two are equally dependent one upon the other, although the enthusiasts on each side will argue with much convincing logic that their work is by far the more important.

Since these two organizations are so dependent upon each other, they should be in close touch and coöperate. That they do not coöperate in very many manufacturing concerns is evidenced by consulting with the executives in either organization. This lack of coöperation may be due to various circumstances, but in nine cases out of ten, where a quiet investigation is made, it is found that it is due to the fact that the general manager has a decided tendency to place more importance upon the work of the one organization to the neglect of the other, or else he is strictly a financial manager who takes little interest in the relations between his factory manager and his sales manager and lets them fight it out between themselves, which they will do to the detriment of the company as a whole. That is to say, general managers are not as a rule *general* managers.

A general manager may gain his position through various means: through personal influence, because of some patent rights which he holds on the product, through his reputation as a financier, or because of the results of his work in some department of that company or another. There are very few general managers who have had experience in both the sales and factory organizations, and that is not necessary, but the majority of them come from the sales organization and for that reason are more interested in and give more attention to the sales end of the business.

There is a reason for the advancement of sales managers to general managers and that is that the results obtained by the sales manager are more apparent, because they bring in the earnings which carry on the business and from which dividends are declared. In the eyes of the directors, and oftentimes of the general manager, the whole life of the business depends upon the sales department. When the net earnings increase, the general manager, consciously or unconsciously, credits it to the sales organization, although the increase may have been due to the factory organization.

There have been many companies grown big because of fine sales departments, and failed because of inefficient factory organizations; and when they have failed it has been with much comment and notoriety, because their sales departments had made them known. There have been and are many manufacturing companies with efficient factory organizations and inefficient sales organizations; some of them have failed and it has caused only local comment, because they were not widely known, and the others are existing in a small way and can only exist in a small way until there be a change in the sales organization.

The wise general manager will watch the development of both his sales and factory organizations; he will make an effort to bring his sales manager and his factory manager to a clearer understanding of each other's work, and will look into the causes for the lack of coöperation between the two departments, because coöperation means increased dividends.

The sales manager thinks of the factory, if he thinks of it at all, as the place where deliveries are held up; and the factory manager too often thinks of the sales department as demanding the impossible and making his work more difficult to carry on; all of which is due to lack of coöperation.

Promised Deliveries

To coöperate properly with the factory, the sales department should keep a careful record of deliveries promised, so that the deliveries will be as far as possible in accordance with the best methods in manufacturing. Sometimes it is of great assistance to the factory organization to have the delivery dates "bunched" or come in close succession for a certain model of machine or a certain variety of the product, whatever it may be; for another model or another variety of the product it may be better to have the delivery dates spread out through the year. Of course, in some lines of selling, the sales department cannot dictate delivery dates to the customer, but usually it is possible by consulting with the factory manager and customer to arrange delivery dates which will be satisfactory all around. As long as sales managers arbitrarily specify shipping dates without considering the factory organization the result will be broken promises, because of the fact that in most manufacturing plants making regular lines, the general manager specifies the amount of each variety of product which is to be made and sold during the ensuing year, and the factory manager, if he would manufacture the good economically, must plan his work all out for the year. Right here is where the sales manager should consult with the factory manager and learn his plans for the year, so that he will not be constantly interfering with them and thus hindering the production and his own work of making sales.

If the factory manager is consulted or properly notified as far in advance as possible, when it is not possible for the sales department to regulate the delivery dates, he can perhaps alter his plans enough so that he will be able to make the deliveries as desired by the sales department. As a general rule the factory manager is not consulted or even considered. By consulting with the factory manager and assisting him, through the adjustment of delivery dates, to manufacture economically, the sales manager can often make a decided increase in the percentage of profit or in the net earnings; and this is as much his duty as it is to see that the output is all sold and to secure as much money for the output as possible.

However, delivery dates cannot always be decided by the factory and sales managers alone. It may be necessary to have deliveries made at certain times, even though the cost of production may be increased thereby, so that the company can have that income to carry on the business and produce more goods which may be made more economically than the first and bring in a greater percentage of profit. This rests wholly with the general manager.

Another cause of trouble between the sales and factory organizations is the "specials;" that is, goods similar to those

regularly manufactured but with alterations to suit some particular customer. Some salesmen are prone to make sales of special goods if the customer expresses the slightest wish to have it special, when, perhaps, if the salesman made more of an effort, the customer would accept and be just as well satisfied with the regular line. Specials cost money to make and seldom does the increase in price cover the increase in cost. Moreover, the manufacture of special goods delays the manufacture of the regular line and by this means the sales department is injuring its business.

SALE OF SPECIALS

Very often the sale of specials seems necessary for the good of the business. This must be decided by the sales manager and the general manager. If a concern is new and the sales department is building up its business against keen competition, the customer's wishes must be considered very carefully, and it may be well to agree to the specials even if a little money is lost on that particular sale. In that case, since the factory manager is supposed to be working, as is the sales manager, for the good of the business as a whole, he must use his best efforts to manufacture the special goods with as little delay as possible to the production of that which is regular; and it may be said that the factory manager who cannot take care of a reasonable quantity of specials is no manager.

PROVINCE OF GENERAL MANAGER

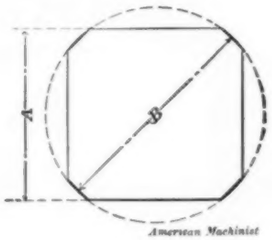
The factory manager must bear in mind that the purpose of the whole business is to make money, and it is part of his job to do all in his power to assist the sales department.

The sales manager, on the other hand, must not forget that he is dependent upon the factory for the goods which he sells.

To keep these things before the sales and factory managers and to make them coöperate is the duty of the general manager; he is the only one who can accomplish this.

Standard Square Holes with Round Corners

The use of squared shafts and corresponding holes in gears, seems to be increasing in both automobile and machine design. In some cases of heavy drilling, keys have been torn out of shafts, making the resort to squared shafting a necessity.



This has been accomplished by the use of broaches and broaching machines, the growth of this method being largely due to the Lapointe Machine Tool Company, Hudson, Mass.

In view of this it is interesting to note the dimensions of such holes as recommended by them, these being given in the table which follows. While the ratio between the sizes of the shaft and the diameter across the flats is not exactly uniform in all cases, it closely approximates 5 to 4, that is, the shaft is 25 per cent. larger than the flat diameter, or the flat is 20 per cent. less than the outside diameter of the shaft.

It will be noted that the corner curves are of a radius struck from the center of the hole, requiring no machining of the shaft other than its being rolled, drawn or turned to the proper diameter.

The sizes given are supposed to be the same for both hole and shaft. When a sliding fit is desired, 0.001 to 0.003 inch should be allowed on the broach.

A, Size of Square.	B, Size Across Corners.	A, Size of Square.	B, Size Across Corners.
No. 1 1 inch	1¼	No. 10 1⅝ inch	1¹³⁄₁₆
No. 2 1⅛ inch	1⅜	No. 11 1¾ inch	2
No. 3 1¼ inch	1½	No. 12 1⅞ inch	2¼
No. 4 1⅜ inch	1¹¹⁄₁₆	No. 13 2 inch	2⅜
No. 5 1½ inch	1¹³⁄₁₆	No. 14 2⅛ inch	2½
No. 6 1⅝ inch	1⅞	N2. 15 2¼ inch	2⅝
No. 7 1¾ inch	2	No. 16 2⅜ inch	2¾
No. 8 1⅞ inch	2⅛	No. 17 2 inch	2⅞
No. 9 2 inch	2⅜		

TABLE OF LAPOINTE STANDARD ROUND CORNERED SQUARE HOLES.

Automobile Engineers Convention

The annual meeting of the Society of Automobile Engineers was held in the Assembly Hall of the Automobile Club of Amerisa, New York City, January 11 and 12, 1911.

The professional sessions program included papers on: Electro Steel, by Joseph Schaeffers; Illustrations of Physical Facts Relating to Metallurgy, by Radclyffe Furness. Reports of Standards Committee on: Iron and Steel; Aluminum and Copper Alloys; Ball and Roller Bearings; Broaches; Gear Metal Constants; Carbureter; Frame Sections; Lock Washers; Nomenclature; Seamless Steel Tubes; Sheet Metals; Springs; Tire Efficiency; Miscellaneous; Influence of Multi-point Ignition on Output and Efficiency of the Internal Combustion Engine, by Otto Heins; the Construction of Highways for Motor Traffic, by Logan Waller Page, United States Director of Good Roads, Department of Agriculture; Leaf Springs, Design and Methods of Mounting and of Treatment by the Manufacturer and the User, by E. K. Rowland; Shock Absorbers; Novelties in Valve Systems, by E. P. Batzell; Hot Rolled Gears, by H. N. Anderson; Commercial Gasolene and the Impurities That Are Being Encountered, by F. H. Floyd; the Test of a 20-Horsepower Franklin Air-cooled Motor, by L. R. Evans and R. P. Lay; Development of the Grinding Wheel, by George N. Jeppson; Methods of Grinding, by John C. Spence; "Frictionless" Friction Drive, by Charles E. Duryea; The Fire Protection Question, by N. B. Pope; Contest Rules That Affect the Engineer, by A. L. McMurtry; The Engineering Lessons of the Motor Car Contest; Automobile Contest Timing and Coaching, by Chester S. Ricker; Report of Standards Committee Division on Wood Wheel Dimensions and Fastening for Solid Tires; Standardization Possibilities in the Commercial Car Field; Advantages of Long-Stroke Motors, by E. A. Myers; Foolproofing the Commercial Car Mechanism and Its Control, by A. J. Slade; Coöperation between the Electric Vehicle Manufacturer and the Central Station, by Robert McA. Lloyd; The Ampere-hour Meter for Electric Vehicles, by R. C. Lanphier and Topical Discussions on Vertical Motors under Foot-Boards versus Vertical Motors under Hood; Proper Power and Speed of Gasolene Motors for Truck Purposes, and Proper Road Speeds for Vehicles of Different Capacities; Chain Drive for Trucks and the Necessity of Housing Same; Type of Transmission for Trucks; Gasolene-Electric Transmissions for Heavy Loads; Tire Mileage and Costs; Multiple Uses for Machines for Municipal Service.

Shot Iron and Hard Spots in Castings

On page 704, Volume 33, Part 2, Thomas D. West, 10,511 Pasadena Ave., Cleveland, Ohio, solicits specimens of iron castings containing globules in gas cavities, solidly incased shot iron, white iron inside of gray or soft iron and hard

streaks of spots in castings. As these phenomena are rare and more specimens desired, the time for their receipt is now extended to March 1, 1911. A paper on this subject will be presented by Mr. West to the American Foundrymen's Association convention, Pittsburg, week of May 23, 1911. Firms sending specimens not wishing their names mentioned will have such requests complied with.

Two Convenient Shop Racks

SPECIAL CORRESPONDENCE

The Cincinnati Planer Company uses in its shops at Cincinnati, Ohio, a number of very convenient racks for different kinds of work and material handled about the shop. Two such racks are shown by the accompanying halftone engravings.

The first of these, Fig. 1, is located near the belt-lacing machine and takes care of medium and short lengths and odds and ends of belting, which may be required at any moment and which are so arranged on the rack as to be easily found whenever needed. The rack is constructed of piping and stands on four flanges attached to the lower ends of the uprights. The pegs in the wood casing around the upper lengths of pipe are arranged to receive the pieces of belting and the table between the uprights forms a handy bench for the belting tools, lacing material, etc. Longer pegs extending inwardly from the four columns carry coils of belting of various widths and lengths.

A Rack For the Painters

The rack in Fig. 2, like the first one shown, explains itself pretty clearly. The two horizontal lengths of pipe between the uprights are surrounded with a wood casing into which pegs are driven for hanging up shifting-mechanism links or similar parts as fast as painted, thus keeping such pieces from the floor or bench where they would otherwise have to be placed. The arrangement keeps the parts clean, is a great convenience to the workmen and adds to the general neatness of the shop. It is of ample size to take care of a large number of parts of the kind illustrated.

FIG. 1. A BELT RACK

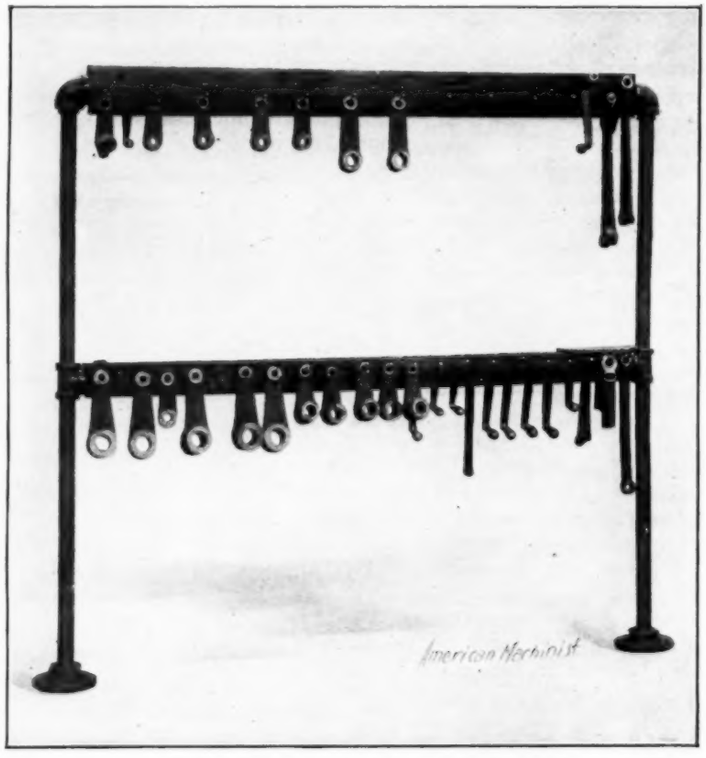


FIG. 2. A RACK FOR THE PAINTERS

Annual Automobile and Aeroplane Exhibition

The eleventh annual international exhibition of the American Motor Car Manufacturers Association was opened in Grand Central Palace, New York, on New Year's eve as usual. The first international aviation show was also held simultaneously with it.

In the pleasure-car department of the automobile show there were something like 40 exhibitors and the prices of the cars ranged all the way from $485 to $5500. But few of the higher-priced cars were shown, however; the vast majority of them being $2000 in price and over half were under $1500.

Power Plants

All of the cars had jump-spark engines, with a magneto and battery, and this might, therefore, be called the Jump Spark Show. Of the four-cylinder engines, 21 makers had the cylinders cast in pairs, while eight makes were cast *en bloc*, and four had the cylinders cast separately. But one two-cylinder opposed engine was shown; one six-cylinder, and one single-cylinder. One had a chain drive, and one a friction drive, all of the balance being shaft driven.

Three-wheeled Cars

Two three-wheeled cars were exhibited, one of which, the "Cylonette," is made in Berlin, Germany, and the "Motorette" is manufactured in this country.

The Cyclonette has two wheels in the rear and one in front. The entire power plant, steering mechanism, etc., is located over the front wheel, so that when this is detached, one only has left a cart on two wheels.

The Motorette is built on the opposite principle of two wheels in front and one in the rear. In this case the two front wheels do the driving and the rear wheel is merely used for steering.

Single-cylinder Car

The novelty of the show was the "Only" car. This has a single-cylinder engine, with 5⅛-inch bore and 10-inch stroke. It is claimed that the engine will develop 16 horsepower, A. L. A. M.

rating, at 600; 21 horsepower at 1200, and up to 53 horsepower at 3000 revolutions.

Commercial Cars

Commercial cars were shown in large numbers, which varied all the way from the light delivery wagon to the ten-ton truck, there being nearly as many as pleasure cars.

Nearly all of the commercial-car exhibitors were firms that do not build pleasure cars. This is possibly due to the fact that a different class of designers and mechanics is required for each type.

Aviation Show

While the aviation show did not have as many individual exhibitors as the automobile show, it was extremely interesting in every way. Everything here was practically new and the attention of the spectators was therefore centered on this part of the show.

Twelve different makes of aëroplanes were exhibited and these were of the regulation monoplane and biplane types. Each one, however, had its variations for which different advantages were claimed. The majority of the machines shown were of the monoplane type.

Aëroplanes in which noted flights were made and copies of those in which noted flights were made, were plentiful. Among these were the machine John B. Moisant drove from Paris to London and that which Glenn H. Curtis drove from Albany to New York.

The Lubrication of Ball Bearings

By W. L. Batt

Ball bearings must be protected against the entry of grit and moisture and must be lubricated. The lubricant must not contain either free acid or alkali. In general, greases are desirable just as far as the speed will permit.

Several examples of mountings to retain lubricant.

The widely extended use of ball bearings in the past few years is in itself a justification of an article concerning their lubrication. This is an element in their operation whose importance has been too little realized and yet one upon which the successful working of ball bearings is most dependent. It is a well known fact that oil is essential for the operation of plain bearings, but it is not so well known that ball bearings likewise require a certain amount of lubrication; it is all too frequently assumed that the latter may run entirely dry.

Contrary to this assumption lubrication has a very positive action in a ball bearing. This action is many fold, existing both between the ball and the path upon which it rolls and between the ball and the separator. Though the principle of the ball bearing is a rolling one, there is in the most perfectly designed bearing a sliding action which, however slight, must yet be provided for. If balls and raceways were absolutely incompressible there would in practice be solely point contact and, therefore, a pure rolling action, but as far as present day mechanical processes go even the most perfect of materials are somewhat elastic and there is an actual area of deformation between the ball and the raceway under load. At the extremities of this area whose diameter is, of course, very small, sliding must exist but the presence of a lubricant at this point renders what small amount of friction there is almost negligible. Improbable as it may seem, there is an actual film of lubricant maintained between these surfaces of contact, however minute they are, providing the lubricant be one of sufficient viscosity.

Protective Value of the Lubricant

Aside from its lubricating quality, oil or grease acts as a protecting agent for the ball bearing. The finely polished surfaces of balls and raceways are subject to attack by rust through atmospheric action and may be damaged by the entrance of foreign matter from the outside, such as grit and dust. Lubricant effectually surrounding the bearing will not be penetrated by this atmospheric moisture and thus the surfaces of action are preserved in their original finely polished condition. If, however, rust or grit should be allowed to attack the carrying surfaces these are quickly destroyed and an earlier failure of the bearing may be expected.

In order that the lubricant may in itself be no source of danger, it must respond to certain requirements; incidentally requirements exacted of the ball-bearing lubricant are thoroughly desirable in one to be used in plain bearings as well.

Requirements of a Ball-bearing Lubricant

First and most vital is that the lubricant of itself shall do no damage to the bearing, neither originally nor through deterioration. The most common fault in oils is the presence of free acid or its development. Free acid is never found in properly refined mineral or hydro-carbon oils, nor will these deteriorate due to the action of the atmosphere, and therefore the only kind of oil satisfactory for ball-bearing lubrication is mineral oil. Vegetable oils, such as castor, cotton seed, rape, linseed and the like are barred, principally because of their tendency to gum up, become rancid and develop acid. The animal oils are objectionable for the same reason. A simple test for the presence of objectionable elements in an oil

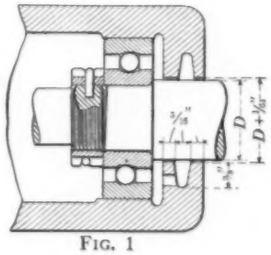


Fig. 1

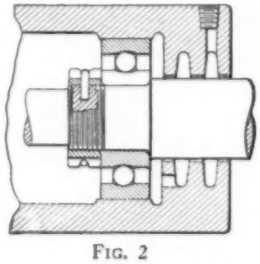


Fig. 2

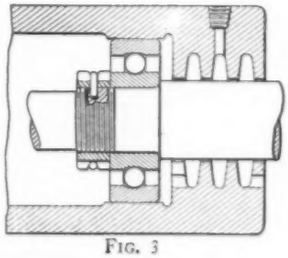


Fig. 3

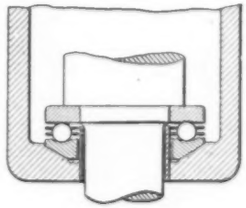


Fig. 4

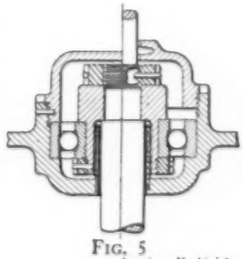


Fig. 5

American Machinist

Examples of Ball-bearing Mountings to Retain Lubricant

or a grease is to coat a finely polished surface of steel or brass or the surface of a ball bearing, with the oil or grease in question and expose it to the sunlight for a few weeks; at the end of that time the steel should show its original polish. Any discoloration or drying up of the lubricant on the steel is sufficient to bar it from consideration. The so called petrolatum greases, among which are vaseline and cosmoline, have no detrimental action in themselves since they are derivatives of mineral oil; they have, however, low viscosity and a low melting point—100 to 125 degrees Fahrenheit; they pound out thin in action and have little lubricating value. Their use is limited to very slow speeds and their chief advantage is low cost.

Just as acid is a thing to be guarded against in oils, so is free alkali the most common enemy to ball bearings among the greases. The familiar yellow cup grease is usually a combination of a mineral oil and some vegetable or mineral oil or fat which latter is saponified by the addition of a caustic; the result is a lubricant having body and stiffness. The saponifying material should be small in quantity and very carefully compounded, else free alkali, having a detrimental action on the steel, may result. The action of an alkali, as of an acid, is to pit or etch the surfaces upon which it is deposited.

The addition of mica, ground cork, wood and such substances, frequently added to overcome noise in gear cases, is a positive menace to the ball bearing, since this foreign matter opposes free ball rotation. If that be present in large enough amount, the result may easily be that the balls are wedged between the raceways and actual fracture may result. Certainly the free rolling quality of the ball bearing will be lost.

The question of the beneficial effect of graphite in ball-bearing lubrication is one often asked. The answer is simply that graphite can in shape or form be of assistance to the ball bearing itself. Whether it is a detriment of enough importance to offset its undoubted advantage to gears or whatever the mounting may be, depends entirely on the kind and fineness of the graphite and the proportions in which it is added to the lubricant.

It may readily be seen that any considerable amount of graphite settling in the bottom of the raceway will interfere with the free rolling of the balls in the same manner as ground cork or any other substance. The claim made for graphite, and one certainly proved in the case of the plain bearing, is that it deposits itself in a fine film on the surface upon which the shaft may revolve. A microscopic examination of the balls and grooves of a carefully made ball bearing shows almost no scratches or inequalities; after such a bearing has been run in oil and graphite of proper proportions, examination again will show that absolutely no graphite has been deposited. Frequent observations carefully made show a slight increase in the friction when graphite is present over that when oil alone is used. Such results clearly show that graphite has no value in so far as reduction of ball-bearing friction may be concerned. Over the usual life of a ball bearing, however, probably no actual damage will result and considerable good may have accrued to the elements carried upon the ball bearings; such use would, of course, be justifiable. The damage, however, from graphites that settle and accumulate in the bearings cannot be overlooked.

Effect of Speed upon Choice of Lubricant

The effect of speed upon the choice of lubricant must likewise be considered. As a general statement, greases are desirable for use up to just as high a speed as is possible. An undue increase of temperature and a thinning out of grease will indicate the limit of its usefulness; when this is noted oil must be employed. Oil has a higher viscosity than grease and theoretically is a better lubricant, but its advantage in this regard is more than offset by the difficulty of its proper retention, in the bearing case. Such case may be solidly packed with grease that will thus not only lubricate the bearing but will also prevent foreign substances from entry. If oil be used the ball will merely dip into the oil, splashing it over the entire bearing, but the bearing is then more open to the entry of foreign matter. There will be more internal friction in the grease than in the oil and it is this that at high speed produces excessive temperature. As a general thing greases may be used up to about 2000 to 2500 revolutions per minute.

Mountings Made to Retain Lubricant

In order that the lubricant may be effectually retained, various arrangements are used, depending upon the conditions surrounding the bearing. Fig. 1 shows the simplest sort of mounting for a radial bearing in which the shaft projects through the casing, and the casing itself is provided with two lips, between which is a space for lubricant. If the condition be such that additional protection is needed, the arrangement of Fig. 2 will be employed. Here one additional groove is provided and this may be fitted with a cup of some sort from which grease will be steadily fed to the groove to keep that filled. This makes a definite frictionless packing. Still more severe conditions will be met by Fig. 3, in which a third groove is added, but in this latter groove felt is occasionally placed, whose adherence to the shaft is guaranteed by some sort of spring tension. Unfortunately, this is subject to drying out and thus loses its efficiency.

The single- or multiple-groove arrangement of Figs. 1, 2 and 3 is the most effective; but it is essential that the bore of the lips be not more than 1/64 inch larger than the shaft, that the lip edges be sharp instead of rounded over, and that the lips be at least 3/32 inch wide.

Figs. 4 and 5 show arrangements for retaining lubricant at the ball level for vertical or inclined shafts. A sleeve projecting to a sufficient hight is interposed between the shaft and the bearing.

An Annealing Wrinkle

By C. N. Hubbard

A neat way out of a difficulty came to my notice recently, and it may be of interest to others. The problem was to put keyways in some small, high-speed steel saws that were hard all over; a file not touching them. They were approximately 3½ inches in diameter, and 1/16 inch thick, with a ⅞-inch hole.

First a gas torch was used to anneal them with by playing the flame around the arbor hole until a good color was obtained. This was no use as the file would bite no better than at first.

Two thick rings, as large as the saws, but with 1¼ inch hole, were next clamped on each side of a saw to protect the teeth. The torch was again used in an effort to anneal a spot for the keyway, but it failed to soften the metal enough for filing.

The third way tried was successful and as simple as it was effective. The saw, with the rings still attached, was placed on a smooth surface. This left a cavity formed by the rings, namely, 1¼ inches in diameter. This was filled with red-hot lead and allowed to cool before taking off the rings. Then the extra metal on one side was chipped away to free the saw, and the keyway was easily filed.

Commenting on the rumored negotiations for the formation of a European aluminum syndicate, the *Ironmongers' Chronicle* has this to say: The use of aluminum for cooking utensils is said to have far exceeded early expectations. It is considered, however, that if the metal be advanced to much over $36 per 220 pounds, which would bring rolled aluminum sheets as employed in the industry to 48 cents per 2.2 pounds, it would be a very difficult matter to compete effectively with enameled iron ware. There is also an increasing tendency to employ the metal in place of copper for electrical cables; in several of the latest Norwegian schemes, for instance, aluminum cables are being adopted. That the aluminum industry itself is still unprofitable is pretty clear, for only those works which have been able to utilize part of their power for other branches of the electrometallurgical or electrochemical industries appear to be obtaining anything like satisfactory results.

Increasing Shop Capacities

METAL WORKING

News items for the sales department — where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip — facts

NEW ENGLAND

New garage to be built at Springfield, Mass., by W. R. Weiser.

More machinery is needed at Chicopee (Mass.) Industrial High School.

The Streeter Jewelry Company is removing its plant from New York to Providence, R. I.

The Lafayette Worsted Company, Woonsocket, R. I., is to have a machine shop added to its plant.

The Thorndike Company is to erect a machine shop and cotton factory at the present plant at West Warren, Mass.

The Hart & Cooley Company, New Britain, Conn., manufacturing metal lockers, etc., is considering the removal of its plant.

The Oscar G. Thomas Company, Taunton, Mass., has been incorporated to manufacture stoves, ranges, castings. Capital, $50,000. Oscar G. Thomas, president.

Marcus Mason & Co., Worcester, Mass., manufacturing sugar and coffee machinery, are in the market for a number of machine tools for new plant being erected at South Framingham, including lathes, planers, boring mill, grinder, punch and shear, etc. The concern is controlled by the Guiler Engineering Company, 10 Broad street, New York.

MIDDLE STATES

Moline Tool Company, Moline, Ill., will probably build a new plant.

The Conneaut (Ohio) Can Company is erecting an addition to its factory.

Kirk & Blum, Cincinnati, Ohio, sheet-metal workers, will build a two-story addition.

The Scranton(Penn.) Bolt and Nut Works has awarded contract for the erection of an addition.

Douredore Brothers, Philadelphia, Penn., will erect a four-story garage at 2314-2318 Market street.

The Pittsburg Steel Company has announced that two blast furnaces will be built at Monessen, Penn.

Contract has been let for a new foundry for the Buhl Malleable Company, at Wright and Adair streets, Detroit, Mich.

Fire partially destroyed the machine plant of the Bagley & Sewall Company, paper-making machinery, at Watertown, N. Y.

Contract has been let for the erection of a new plant at Detroit, Mich., for the Bower Roller Bearing Company, of Dayton, Ohio.

The Campbell Magnetic Separator Company, Cuba City, Wis., manufacturers of separators and roasters, will erect a large plant.

Fire partly destroyed the plant of the Bagley & Sewell Company, manufacturing paper machinery, at Watertown, N. Y. Loss, $40,000.

The American Suction Cleaner Company, New York, has been organized with $25,000 capital by E. N. Burns, J. Devine, E. F. Sause.

The Kissel Motor Car Company, Hartford, Wis., is looking for site for a new plant. Large plant giving employment to over 1000 men is proposed.

Ciner & Seeleman, New York, have incorporated with $50,000 capital to manufacture jewelry. Incorporators, I. W. Neuwirth, L. Seeleman, E. Ciner.

The Geiser Manufacturing Company, of Waynesboro, Penn., making agricultural implements, will erect a warehouse and repair plant in Trenton, N. J.

The Bauer Metal Body Company, Detroit, Mich., is seeking site for the erection of a new factory. M. D. Bauer, 792 St. Antoine street, can be addressed.

Plans are being prepared by Spier, Rohns & Gehrke, Chamber of Commerce building, Detroit, Mich., for an automobile plant for John Beyster, to cost $20,000.

The Laporte Meter Company, Laporte, Ind., has been incorporated to manufacture gas meters. Capital, $150,000. Incorporators, V. P. Wilkins, Emmet Scott, etc.

Thomas L. Green & Co., Indianapolis, Ind., have incorporated to manufacture bakers' machinery. Capital, $40,000. T. L. Green, A. P. Green, L. R. Sereinsky, etc.

It is announced that the Delaware & Hudson Company proposes to centralize its heavy repair work in Albany and new shops to cost over $1,500,000 will be erected there.

The Wilcox Auto Company, Plainfield, N. J., has been incorporated to manufacture automobiles, etc. Capital, $25,000. Incorporators, A. R. Wilcox, A. C. Wilcox, A. S. Logan.

The Toledo (Ohio) Molyneux Company, manufacturing patent mailing devices, has increased its capital stock to $200,000, and proposes to build a new plant in Toledo.

The Gas Electric Car Company, Jersey City, N. J., has been incorporated by S. S. Moore, D. A. Newton and Clement K. Corbin, to manufacture railway cars, trucks, etc.

The Rutan Auto Company, Port Jervis, N. Y., has been incorporated to manufacture aëroplanes and operate garage. Capital, $45,000. Incorporators, Peter C. Rutan, J. Rutan, etc.

The Peoria Metal Culvert Company, East Peoria, Ill., has been organized to manufacture corrugated metal culverts. Capital, $40,000. Incorporators, A. B. Fink, F. J. Feldt, W. V. Tefft.

The Limbert Manufacturing Company, Springfield, Ohio, has been incorporated to manufacture a new flue blower. Capital, $20,000. Incorporators, S. H. Limbert, O. C. Clark, C. L. Steele, etc.

The Trenton (N. J.) Safe and Lock Company has been incorporated to manufacture and deal in safes and locks. Capital, $10,000. Incorporators, Edward R. Solliday, H. M. Solliday, Jas. N. Carhart.

The Peru Electric Company, Peru, Ind., has filed articles of incorporation. Capital, $100,000. Incorporators, Wm. H. Zimmerman, J. N. Miller, J. Kramer. Will manufacture electrical supplies.

The Grabowsky Power Wagon Company, Chicago, Ill., has been organized to manufacture motor vehicles and accessories. Capital, $25,000. Incorporators, H. L. Newman, E. O'Conor, W. W. Witty.

It is said the engineering board of the United States Steel Company has approved plans for the plant of the Minnesota Steel Company, at Duluth, Minn. The plans call for an expenditure of more than $10,000,000.

Niles Iron and Steel Roofing Company, Niles, Ohio, has been organized with $40,000 capital to manufacture and sell all kinds of steel and iron roofing, etc. Incorporators, W. H. Pritchard, P. E. Pritchard, Ruth Naylor, etc.

The Universal Tobacco Machine Company, New York, has been incorporated to manufacture machinery for handling tobacco, etc. Capital, $350,000. Incorporators, G. C. Sherman, F. G. Elder, New York; C. P. Day, East Orange, N. J.

It is reported that the Kerff Company, Thomas building, Wall and Center streets, Lansing, Mich., is organizing for the purpose of building a factory on East Franklin avenue, including a machine shop and nickel-plating plant.

The Humphrey Gas Pump Company, of Syracuse, N. Y., has been incorporated with $1,500,000 capital. William B. Cogswell and Edward N. Trump, Syracuse, are directors. For the present its patented pump will be manufactured by machine companies.

SOUTHERN STATES

The Cleveland (Tenn.) Machine Works will erect an addition to its plant.

The Auto Exchange and Supply Company, Tuscaloosa, Ala., will erect a garage.

The New Orleans (La.) Roofing and Metal Works will erect additions to its plant.

Southern Blower and Manufacturing Company, Memphis, Tenn., contemplates installing equipment for the manufacture of stove pipe.

The International Safe and Lock Company, New Orleans, La., has been organized to manufacture safes and locks. Capital, $50,000. Incorporators, W. B. Gillican, B. H. Menge, H. W. Woodruff, etc.

WEST OF THE MISSISSIPPI

George Levins, of Treat, S. D., will erect a blacksmith shop.

Lewis Svingen, of Brandon, Minn., will erect a blacksmith shop.

N. I. Waldahl, of Sentinel Butte, N. D., will erect a blacksmith shop.

The Fairbury (Neb.) Windmill and Machine Company will erect a two-story factory.

W. W. Moore, Box 478, Yoakum, Tex., is in the market for complete equipment for a coal mine.

The Hunter Iron Works, of Atlantic, Iowa, will install a 40-horsepower motor and other machinery.

The Standard Motor Car Company, Los Angeles, Cal., will enlarge its garage and repair shop.

Fire partly destroyed the plant of the St. Louis (Mo.) Machinery Company, causing a loss of about $12,000.

The Oklahoma City (Okla.) Railway Company has made appropriation for the construction of a repair shop.

Hare & Son, Westminster, Cal., will build a commercial garage and repair shop. Modern facilities will be installed.

The Woods Electric Car Company, Los Angeles, Cal., will establish a garage and repair shop on Pico street. Modern repair machinery will be installed.

The Queen Bee Stove Company, Joplin, Mo., has been incorporated with $50,000 capital to manufacture stoves. Incorporators, J. E. Crosbie, Jas. E. Walde, Jas. E. Ward, O. D. Hunt, etc.

The Northwestern Steel Cabinet Manufacturing Company, Minneapolis, Minn., has been incorporated with $50,000 capital to manufacture steel cabinets, boxes, electric fittings, etc. Incorporators, R. W. Burnet, C. D. Parsons, J. G. Burnet.

Tri-City Railway Company, Davenport, Iowa, officially announces that the sum of $1,000,000 will be expended for permanent improvements during 1911. These improvements will include building of new car barns in Rock Island, Ill., and equipment of new repair shops.

CANADA

The Waterous Engine Works, of Brantford, will build a $50,000 addition to its plant.

The United Shoe Machinery Company is erecting a big new factory at Maisonneuve, Quebec.

The Wallaceburg Brass and Iron Manufacturing Company will locate a factory at Wallaceburg, Ont.

J. B. Prendergast, of Ottawa, is connected with the Canadian Electric Automatic Machines Company, which will locate there.

C. S. McDonald, of Toronto, is interested in the McDonald & Wilson Company, which will manufacture heating, gas and electric fixtures.

It is reported that the Grand Trunk Railway is considering Valleyfield, Province of Quebec, Canada, as a place for extensive car works and for the building of engines.

MEXICO

The Parral & Durango Railroad, Parral, Mexico, will install new equipment in its machine shops.

General Manufacturing

NEW ENGLAND

The E. P. Woods planing mill, Rumford, Me., was destroyed by fire.

The Hudson (Mass.) Comb Company is to equip a factory with machinery.

C. F. Melinde, Hudson, N. H., is building an addition to his engine room.

Glendale Rubber Company, of Easthampton, Mass., will make improvements.

City of Woburn (Mass.) is considering the purchase of a new stone crusher.

The Index Company, Providence, R. I., is in the market for a paper cutter.

G. L. Winn, Leominster, Mass., intends to equip a comb factory in that town.

Chas. E. Sprague Box Company will build new and larger factory in Lynn, Mass.

The Bigelow Carpet Company, Clinton, Mass., is to equip its looms with motors.

The Rivulet Worsted Mills, Uxbridge, Mass., is to be equipped with modern machinery.

The Armour Meat Company is to erect a new refrigerator plant at Westboro, Mass.

The Providence (R. I.) Brewing Company is to expend $30,000 for new additions to its plant.

It is said the Sorosis Shoe Company, of Lynn, Mass., contemplates the removal of its plant.

Stevens Oyster Company, of South Norwalk, Conn., will rebuild plant recently burned.

The Standard Furniture Company, Portland, Me., is in the market for an air compressor.

The Monarch Steam Laundry, Orange, Mass., is in the market for laundry machinery.

It is stated the Lowell (Mass.) Bleachery is considering the establishment of a branch plant in the Central West.

The Pacific Mill, Lawrence, Mass., is to install a steam turbine and electric generator of 3250 kilowatts capacity.

The Morrison Electrical Company, Boston, Mass., is in the market for a 15-kilowatt direct-connected generating set.

Williams Basket Manufacturing Company, of Northampton, Mass., is to expend $29,000 to replace plant burned by fire.

Principal of Bradford-Durfee Textile School, of Fall River, Mass., recommends introduction of new machinery for the school.

The Lynn (Mass.) Storage Company is to erect a warehouse and cold-storage plant, to be one of the largest in New England.

The Shambow Shuttle Company, Woonsocket, R. I., contemplates new buildings—two-story mill, boiler house and dry house.

The Kelley Manufacturing Company is equipping a factory on Newton street, Waltham, Mass., for the manufacture of bottles.

The Baer-Wilde Jewelry Company, Attleboro, Mass., has purchased 11,000 square feet of floor space, which will be used in connection with its factory.

Alfred Kimball is erecting a two-story addition to his shoe factory on Blanchard street, South Lawrence, Mass. New power house will also be built.

The Finance Committee has recommended an appropriation of $1000 for equipment for the woodworking department at Smith's Agricultural School, Northampton, Mass.

Item in the December 29 issue saying that the plant of the Victor Sporting Goods Company, Springfield, Mass., was destroyed by fire, is incorrect. Fire simply caused damage in the shipping room and one department, manufacturing facilities not being affected.

MIDDLE STATES

The Clay Products Company, Canton, Ohio, will build a new plant.

The Antigo Lumber Company, of Antigo, Wis., will build a sawmill.

The G. & J. Tire Company, Indianapolis, Ind., is enlarging its plant.

The Mount Vernon (Ohio) Window Glass Company will build a new plant.

Fire destroyed the pretzel bakery of M. S. Rupp, Columbia, Penn. Loss, $10,000.

The grain elevator of Lorris Brothers, Oneonta, N. Y., was burned. Loss, $50,000.

Fire partly destroyed the paper mill of the Harding Paper Box Company, Paterson, N. J.

The Krebs Pigment Chemical Company, Newport, Del., will double the capacity of its plant.

The town of Woodbury, N. Y., is considering the construction of a municipal water plant.

The mattress factory of Harris Sussman, 2369 Second avenue, New York, was destroyed by fire.

The Moores & Ross Milk Company, Columbus, Ohio, will build a $25,000 addition to its plant.

The Ahnapee Veneer and Seating Company, Birchwood, Wis., is erecting an addition to its plant.

The Barber Chair Company, Hastings, Mich., is having pains prepared for a two-story factory.

Improvements will be made to the power and light plant at the Boys Industrial School, Lancaster, Ohio.

The Rector Gas Lamp Company, 131 West Thirty-first street, New York, will locate in Scranton, Penn.

The Duquesne Light Company, Pittsburg, Penn., will erect a new power house on Shakespeare street.

The American Vulcanized Fiber Company, Newark, Del., will make extensive additions to its power plant.

The Jersey City (N. J.) Printing Company has awarded contract for the construction of a $150,000 building.

The Piqua Handle Company, of Thompsonville, Mich., is reported to be considering the removal of its plant.

Sicken & Co., Marine City, Mich., are contemplating rebuilding their salt plant, which was burned recently.

Fire caused $15,000 damage at the wall-paper plant of Joseph Ryan, 1352 Fulton street, Brooklyn, N. Y.

People's Power Company, Rock Island, Ill., plans extension and improvements at its gas and electric-light plant.

The petroleum plant of the Standard Oil Company, at Whiting, Ind., recently destroyed by fire, is to be rebuilt.

The National Chicory Company, Pinconning, Mich., is planning the erection of another factory to cost $35,000.

It is reported that the Hoyne Powder Company, of Massillon, Ohio, will remove its plant to Terre Haute, Ind.

The Hammond-Standish Company, 20 Cadillac Square, Detroit, Mich., will have a five-story packing plant erected.

The John Morrison Brush Company, Lansingburg, N. Y., whose plant recently burned, is planning to rebuild same.

The plant of the Beekman Woodworking Company, Bath, N. Y., was damaged by fire to the extent of about $15,000.

The Linde Air Products Company, of Buffalo, N. Y., has secured site at Pittsburg, Penn., on which a plant will be erected.

The Blakely Printing Company, Chicago, Ill., will erect an eight-story building at Market and Congress streets to cost $400,000.

The Riley Shoe Manufacturing Company, Columbus, Ohio, will erect a five-story addition to its factory at 326-328 South Front street.

F. J. Lewis Manufacturing Company, Moline, Ill., plans expansion of its plant. The concern manufactures building paper and roofing.

Contract has been awarded for the erection of a new factory for the Kaufmann Dyeing and Cleaning Company, 1448 Woodward avenue, Detroit, Mich.

The Standard Oil Company has received a permit to erect a $15,000 building in New Rochelle, N. Y., including a pumping house and iron tanks.

S. J. Peck and A. P. Bolner, Eaton, Ind., are preparing to let a contract for the erection of a factory to manufacture a newly patented hose reel.

Griess, Pfleger & Co., Cincinnati, Ohio, manufacturing leather and findings, is preparing to erect a new factory to replace the one recently burned.

The Oval Wooden Dish Company, Traverse City, Mich., has been making an investigation with a view of securing site for a new plant to employ about 1000 men.

The Delaware Glue Company, Newport, Del., has been succeeded by the Consolidated Agricultural Chemical Company. Plant is being overhauled and enlarged.

The American Viscose Company, which has built a new factory at Marcus Hook, Penn., will buy power at present, but will install full power equipment in the near future.

Albert Trostel & Son, Milwaukee, Wis., will erect a $12,000 factory building on North Water street, to replace the one burned some time ago. Patent leather will be manufactured.

The Cement Tile and Construction Company, New Madison, Ohio, has been organized to manufacture and deal in cement products. Howard C. Kitring, Charles E. Burns, E. O. May, incorporators.

Wright Carriage Body Company, Moline, Ill., will add a $10,000 building to its plant and fully equip same during 1911. Official announcement is made, but definite plans have not been prepared.

T. H. Deppers, of Kansas City, and E. J. Williams, of Shiocton, Wis., and Robert Kuehne, of Seymour, Wis., will erect a cold-storage plant at Pulaski, Wis., for preserving cabbages and other vegetables.

S. S. and T. B. Davis, Rock Island, Ill., will erect and equip a big power house on Rock river. The supply of power will be sufficient to supply a city of 100,000 people. Much machinery will be needed.

The Imperial Hoop Company, of Fort Wayne, Ind., has purchased the plant of the Bucyrus Cooperage Company, at Bucyrus, Ohio, and will operate it in the future after making a number of improvements.

Carrollton Pottery Company, Carrollton, Ohio, has been incorporated to manufacture and sell all kinds of clay products. Capital, $100,000. Incorporators, E. L. Henderson, A. E. Albright, L. E. Henderson, etc.

North Baltimore Service Company, North Baltimore, Ohio, has been organized with $30,000 capital to erect and operate a gas and electric plant. Arthur J. Darton, Ralph S. Holbrook, and others, incorporators.

The McCrillis Handle Manufacturing Company, which has plants at Norwalk and Nellie, Ohio, will soon install new machinery in the Nellie plant. The improvements will consist of a new boiler and engine and other machinery.

The Andrew Kimble Company, Zanesville, Ohio, has been incorporated with a capital of $75,000 to manufacture and sell all kinds of vehicles and parts. Andrew Kimble, Frank A. Kimble, C. F. Kimble, J. E. Kimble and Ross H. Kimble.

Dayton Paint and Hardware Supply Company, Dayton, Ohio, has been incorporated with $25,000 capital to manufacture and sell all kinds of paints, varnishes, painters' supplies and hardware. Incorporators, William A. Handt, Charles L. Woolenkamp, Harry Pott, etc.

Northern Ohio Power Company, Akron, Ohio, has been incorporated with $10,000 preliminary capital, which will be increased to $3,000,000 soon, to erect a number of electrical power plants along the Cuyahoga river to supply current to Summit county and surrounding counties. Incorporators, Will Christy, Charles Currie, Charles H. Lohr, etc.

SOUTHERN STATES

The Standard Sewer Pipe Company, Rome, Ga., will enlarge its plant.

The city of Fairburn, Ga., will vote on issuance of $10,000 bonds for an electric-light plant.

Smithfield, Va., will vote on issuance of $55,000 bonds for electric-light and sewerage systems.

The Florence (Ala.) Wagon Works is looking for suitable site on which to erect a new plant.

The Davis Hosiery Mills, Chattanooga, Tenn., has awarded contract for the erection of an addition.

It is reported the Jacksonville (Fla.) Electric Company will erect a power house on Riverside avenue.

The H. L. Judd Company will rebuild its curtain-pole plant, recently burned, at East Chattanooga, Tenn.

The city of Martinsville, Va., voted to issue $35,000 for improving its electric-light plant and waterworks.

The Thornhill Wagon Works, Lynchburg, Va., is considering plans for rebuilding its plant, recently burned.

The Baltimore (Md.) Hub and Wheel Manufacturing Company will erect a $50,000 plant on Harford road.

The Maryland Bleach and Dye Works, Baltimore, Md., is preparing to rebuild its plant partially destroyed by fire.

The Norfolk & Western Railway will enlarge its power house at Bluefield, W. Va. Two additional boilers will be installed.

The town of Roberta, Ga., will receive bids through W. J. Marshall, Lizella, Ga., for the construction of electric power and pumping plant, etc.

Contract has been awarded for the erection of a large new engine and power house for the Atlantic Ice and Coal Corporation, at Albany, Ga.

The Helen Cotton Mill Company, Selma, Ala., is planning to invest $70,000 in automatic looms for its plants and making general improvements.

Plans are about completed for a new power house for the Union Power Company, Hagerstown, Md. O. G. Keilholtz, Continental building, Baltimore, is engineer.

The Woodlawn (Ala.) Ice Company has been incorporated with $40,000 capital for the purpose of manufacturing ice. W. J. Worthington, president and treasurer.

WEST OF THE MISSISSIPPI

Jamestown, N. D., will have a new gas plant.

L. C. Peterson, of Spencer, Iowa, will erect a creamery.

The Rapid City (S. D.) Packing Company will triple its capacity.

The Los Angeles Creamery, Los Angeles, Cal., is completing a new plant.

The city of San Bernardino, Cal., will make improvements in its sewer system.

Swift & Co., of Chicago, will erect a cold-storage plant at Muskogee, Okla.

The Minot Hide and Tanning Company, of Minot, N. D., will erect a tannery.

Falls City, Ore., will issue $30,000 bonds for the construction of waterworks.

The Sperry Flour Company, Oakland, Cal., is building an addition to its factory.

Whittemore, Iowa, has voted to issue $7000 bonds for municipal waterworks system.

Swift & Co., of Chicago, Ill., contemplate the erection of a plant at Oakland, Cal.

The Conway (Ark.) Board of Trade is negotiating for a spoke and handle factory.

S. M. Hubler, near Winchester, Cal., is installing a pumping plant on his property.

M. P. Nelson, of Seattle, Wash., will erect a plant for glazing pottery at Everett, Wash.

The Western Packing Company, Denver, Colo., is in the market for an air compressor.

The Heinz Pickling Company will increase the capacity of its plant at Muscatine, Iowa.

The Harper Brush Works, of Fairfield, Iowa, was destroyed by fire. Will be rebuilt.

The West Oregon Lumber Company, Linnton, Ore., will install new machinery at its plant.

The California Canneries Company is remodeling its plants in San Francisco and Napa.

The power house of the Acetylene Gas Company, Ashley, Minn., was wrecked by an explosion.

The Oakland Brewing and Malting Company, Oakland, Cal., is building an addition to its plant.

The Anaheim Union Water Company, Anaheim, Cal., contemplates improvements in its water system.

The Calexico Creamery Association, Calexico, Cal., will build a creamery and cold-storage plant.

The Nehalem River Lumber Company, Hillsboro, Ore., is installing new apparatus at its plant.

The Libby Waterworks, Electric Light and Power Company, Libby, Mont., will install a lighting system.

The Olympia Railroad and Power Company, Elma, Wash., is planning for extensive power-plant enlargements.

The Siloam Springs (Ark.) Ice and Cold Storage Company's plant was destroyed by fire. Loss, $150,000.

The Truckee River General Electric Company, Reno, Nev., will build a power plant on the Truckee river.

The Pacific Electric Railway Company, Los Angeles, Cal., will establish a rock quarry on its LaHabra division.

The Los Angeles Midway Oil Company, operating in the Midway district, Cal., is installing a power plant.

The city of Leavenworth, Wash., is planning for the construction of a water-supply system to cost $40,000.

E. H. Libby, Lewiston, Ore., has been granted a franchise to engage in a light, heating and power business.

The Delta Creamery, Imperial, Cal., is making improvements in its plant and installing new equipment.

The Oro Water, Light and Power Company, Oroville, Cal., will expend $70,000 in improvements to its system.

The city of Alturas, Cal., contemplates improvements in its waterworks system. Bonds for $33,000 will be voted.

The Eastern Oregon Light and Power Company, Canyon City, Ore., will build a hydro-electric plant at Lagoon lake.

The Syverson Lumber and Shingle Company, Montesano, Wash., is replacing its plant recently destroyed by fire.

The Farmers' Union, Chico (Butte county), Cal., will build a large modern warehouse and install a refrigerating plant.

The Oklahoma City (Okla.) Railway Company will spend $125,000 in making additions to its power station at Belle Isle.

The Santa Fe Railroad, Los Angeles, Cal., will build a concrete warehouse on its wharf. Modern equipment will be installed.

Matthews & Loughlin, of Eagle Cliff, Wash., will erect a manufacturing plant to include sawmill, box factory, barrel factory, etc.

The Hughes Manufacturing Company, Los Angeles, Cal., manufacturers of sashes, doors, etc., is building an addition to its plant.

The city of Douglas, Ariz., has completed plans for a municipal water system and will receive bids on equipment up to January 19.

The Portland-Alaska Packers' Association will build a new cannery on Nushagak river, Alaska, to replace the one recently destroyed by fire.

The Northwestern Development Company,

Spokane, Wash., will build a hydroelectric plant of 30,000 horsepower; $1,800,000 will be expended.

The Porter Fish Company, Anacortes, Wash., is making improvements in its manufacturing plant. New canning machinery will be installed.

The Outer Harbor Canning Company, San Pedro (Los Angeles), Cal., contemplates the erection of a fish-canning factory. John A. Anderson, president.

The Centreville (Iowa) Light, Heat and Power Company is planning to rebuild its central heating system and will install a new 300-horsepower boiler.

The city of Oakland, Cal., will make improvement in its sewer system. Plans are being prepared by City Engineer Turner. A pumping station will be built.

The Alaska Fishermens Packing Company will erect a new cannery of 1200 cases daily capacity on the Koggiung river, Alaska. The company is located at Astoria, Wash.

The Twin City Light and Traction Company will erect a large new generating plant at Chehalis, Wash. Headquarters of the company are in the Fenton building, Portland, Ore.

The International Fisheries Company contemplate the erection of large canning factories on the Pacific coast and Gulf of California. A. Sandoval, Los Angeles, Cal., is the head of this company.

The National Soda Manufacturing Company will build a large soda-refining factory at Newport Beach, Cal. A power plant comprising Corliss engines, air compressors and generating equipment will also be installed. The pumping plant will consist of two 110-horsepower crude-oil engines, two 750-gallon power pumps, two 200 cubic feet, 50-pound belted air compressors, one Simplex type Venturi meter; station piping, valves, etc. One 5-ton hand crane, one 200,000-gallon, 50-foot steel water tower will be installed; hydrants, valves and nozzles are included. Plans and specifications on file at engineers, E. T. Archer & Co., Beals building, Kansas City, Mo.

CANADA

Gleichen, Alberta, will install a new waterworks system.

Sydney, N. S., is in the market for street and road-making machinery.

Turbine pumps will be installed in the pump house at Belleville, Ont.

Chilliwack, B. C., will spend $40,000 extending its waterworks system.

The Canada Keg and Barrel Company, Orillia, Ont., will erect a factory.

The Herald Publishing Company, of Montreal, is equipping a complete new plant.

The Canadian General Electric Company will build a $100,000 power house at Auburn, Ont.

The Canadian General Electric Company is building a very large new power house, near Peterboro, Ont.

F. G. Mitchell, of London, Ont., is interested in the large new knitting works that will locate there.

The building of the Canoe Manufacturing Company, at Lakefield, Ont., was completely destroyed by fire.

Strathcona, Alberta, will considerably increase the electrical equipment in its municipal power plant.

The Saraguay Electric and Water Company will build a $250,000 power plant to be equipped with steam turbines.

Strachan Johnston, of Toronto, is connected with the Central Canada Power Company, capitalized at $10,000,000.

Regina, Sask., is in the market for one hand-power traveling crane, one economizer and one coal and ash conveyer.

Vancouver, B. C., will buy one 1500-kilowatt steam turbine generating unit and one 500-kilowatt direct-current generating unit.

MINING

W. W. Hurt, Searchlight, Nev., will erect a reduction plant at his mine.

The Sonora Verde mines, in the Magdalena district, Mexico, will install a reduction plant.

The Eureka-Johnnie Gold Mining Company, Johnnie, Nev., will build a reduction plant early in 1911.

C. A. Terwilliger, operating the Rawhide property, near Santa Ana, Cal., will install a new equipment.

The La Compania Metalurgica y Refinadora del Pacifico will build a smelting plant at Mazatlan, Mexico.

The Twin Peaks Mining and Milling Company, Twin Peaks Camp, New Mexico, will install a mill at its mine.

The Butte Central Copper Company, operating the Ophir mine, near Butte, Mont., will build a concentrating plant.

Manuel Iturbia, operating the Fannie mine, in the Guanacevi district, Mexico, contemplates enlarged development work.

The Gold Hill & Iowa Mines Company, operating at Quartzburg, Boise county, Idaho, is planning for extensive development.

The Granby Consolidated Mining and Smelting Company will install a crushing plant at its mine, Phœnix, B. C.

The La Gracia Mining Company, operating in the Black Hills district, near Prescott, Ariz., will install an ore-treatment plant.

The Gold Queen Mining Company, operating in the Courtland district, Cochise county, Arizona, contemplates the erection of a mill.

The Mascot Copper Company, operating in the Sulphur Springs Valley district, Cochise county, Arizona, contemplates the erection of a smelter.

The Climax Mining Company, operating in the Hassayampa district, near Prescott, Arizona, contemplates the erection of a large reduction plant.

The Tonopah Mining Company, Goldfield, Nev., is planning to acquire property in the Aurora district, and will make extensive development in the spring.

The 29 Palms Reduction Company, operating in the Park mining district, San Bernardino and Riverside counties, Cal., will install a 50-ton concentrating plant.

The San Lorenzo Mining and Smelting Company, Wilkesbarre, Penn., operating in the San Lorenzo district, Sinaloa, Mexico, will install a 100-ton smelter during 1911.

The Tajo Mining Company, of New York, operating the Tajo mines, in the San Sebastian district, Mexico, is installing new equipment: a 250-ton hydroelectric plant is being built.

The Neill Development Company, operating in the Altar district, Sonora, Mexico, will build an ore-treatment plant to cost $20,000. If successful, a $200,000 concentrating plant will later be installed.

FORTHCOMING MEETINGS

Society of Automobile Engineers, annual meeting, January 11 and 12, New York City; C. F. Clarkson, secretary, 1451 Broadway, New York City.

The National Civic Federation, eleventh annual meeting, January 12-14, New York City; D. L. Cease, secretary, 1 Madison avenue, New York City.

National Metal Trades Association, annual meeting, April 14, 1911, New York City, Hotel Astor. Robert Wust, commissioner, New England building, Cleveland, Ohio.

American Foundrymen's Association, annual convention, Pittsburg, Penn., May 23 to 26, 1911. Richard Moldenke, secretary, Watchung, N. J.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. S. Clark, secretary, 141 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

Philadelphia Foundrymen's Association; meetings first Wednesday of each month, Manufacturers Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care, 505 Pearl Street, New York, will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

MISCELLANEOUS WANTS

B. Jahn, New Britain, Conn., makes dies, tools, specialties and stampings.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Work for screw machines and gear cutter. Box 775, AMERICAN MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Makers of lathes, drill presses, crank shapers, please send catalogs. Address 3521 Third St., Des Moines, Ia.

Special machinery designed; drafting, tests, reports. Reliance Eng. Co., 113 Beekman street, New York City.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

The Brunswick Refrigerating Co., of New Brunswick, N. J., are prepared to take on one or more manufacturing propositions.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Wanted—Machine shop to manufacture and market new labor-saving machine without any competition; royalty or cash. Box 258-A.

Large English firm of machine tool importers having showrooms and offices in Great Britain, France, Germany, Italy, India and Japan is wanting good agencies for machine tools of all kinds. Box 189, AMER. MACH.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the offices of the company, in the Hallenbeck Building, 497-505 Pearl St., Borough of Manhattan, New York City, N. Y., on Tuesday, January 31, 1911, at 12 o'clock noon. Dated, New York City, December 9, 1910. Robert McKean, secretary.

HELP WANTED

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Wanted—First class machinist and toolmaker, one who can take charge of tool room, design new tools and improve old methods; must be alive and competent to produce results; give full particulars as to age, experience and wages expected. Address AMERICAN MACHINIST, X50, 150 Michigan Ave., Chicago.

Wanted—Foreman machinist for shop employing about twenty men, manufacturing special and woodworking machinery, in old established business in Chicago; one with technical education and some inventive ability preferred; can acquire interest in business if desired; state experience and full particulars; all replies confidential. Address AMERICAN MACHINIST, Z 21, 150 Michigan Ave., Chicago.

INDIANA

Wanted—Foreman to take charge of drop forge department, consisting of thirty hammers, twenty board drops and ten steam hammers; must be experienced in handling alloy steel forgings; none except experienced first class men need apply. Box 325, AM. MACH.

MICHIGAN

Wanted—Experienced assemblers and mounters for machine tool work; steady work and good wages to the right men; ideal shop conditions. Grant & Wood Mfg. Co., Chelsea, Mich.

Foreman wanted with general machine shop experience on automatics and semi-automatics, lathes, milling machines and drill presses by large manufacturing concern in the Middle West; give age, details of experience and wages expected. Box 333, AMER. MACH.

MISSOURI

Wanted—Inspector on machine work in large manufacturing company in the West. Box 303, AMERICAN MACHINIST.

Draftsman with experience on adding machines and typewriters; state qualifications and salary; also mechanics for experimental department, accustomed to small accurate work. Address Dalton Adding Machine Company, Poplar Bluff, Mo.

NEW YORK

Ambitious and skilled tool room mechanic wanted; must have had experience and be interested in efficiency work. Box 341, AM. M.

Wanted—Experienced draftsmen for steam piping, structural steel and furnace work in small town, New York State. Box 308, AM. M.

Toolmaker; first class man; American; used to small, accurate work; highest wages; steady work. Address Box 173, Mount Vernon, N. Y.

Milling machine hands wanted; first-class men for Cincinnati plain and universal machines; steady employment, good wages. F.I.A.T., Poughkeepsie, N. Y.

Wanted—First class all-around machinists and toolmakers; state age, experience, married or single and wages expected; steady position for good men. Address P. O. Box 65, Elmira, N. Y.

Wanted—First class screw machine hands, lathe hands, milling machine hands and draftsmen, experience in automobile work; good wages, steady positions. Apply by letter. Maxwell-Briscoe Motor Co., Employment Bureau, Tarrytown, N. Y.

OHIO

Wanted—Experienced man capable of taking full charge of assembling automobile engines; give age, experience and salary. Box 323, AMERICAN MACHINIST.

Wanted—Works manager for a plant building special machinery; have foundry, sheet iron shop, machine shop and woodworking machinery; employ 350 to 500 men; want man capable of taking entire charge of manufacturing; a good opportunity. Box 346, AMERICAN MACHINIST.

Wanted—First class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood and metal patternmakers, brass polishers, buffers, finishers, millwrights, hammermen and blacksmiths, who wish to increase their opportunities, to register with the free Employment Department of the National Metal Trades Association, New England Building, Cleveland, Ohio.

PENNSYLVANIA

Several first class diemakers for accurate work. Box 342, AMERICAN MACHINIST.

Wanted—First class stoker and mechanical draftsman; in reply state experience, age, reference and salary expected. Box 322, AMERICAN MACHINIST.

Wanted—Young mechanical engineer as associate editor of the Lefax Engineers' Loose Leaf Pocket Book. Address, stating experience and salary, Standard Corporation, 1006 Pennsylvania Bldg., Philadelphia, Penn.

Wanted—Superintendent to take full charge of factory over one hundred men, manufacturing steam and gas engine and boiler trimmings; must be a hustler with experience in running a shop in this same line. Box 343, AMERICAN MACHINIST.

Pump draftsman, first class, experienced man capable of designing simple and compound direct acting steam pumps for mine use; permanent position with good salary to the right man; don't apply unless you are thoroughly competent; give full particulars. Box 319, AMERICAN MACHINIST.

Assistant foreman wanted for a machine shop, for medium and heavy work; must be able to handle men and be familiar with modern machine tools to turn out work to the best advantage; permanent position for the right party; state age, experience and salary desired. Box 329, AMER. MACHINIST.

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

WEST VIRGINIA

Wanted—Experienced die setter to take charge stamping department of can factory; state experience, salary and present employment. Address "Die Setter," AM. MACHINIST.

Wanted—Man with considerable mechanical experience, mechanical engineer preferred, to superintend large stamping and manufacturing plant; must have fair education and executive ability; state experience and give present employment. "Stamping," AM. MACH.

WISCONSIN

Expert tool designer, having shop experience as well as technical training in pressed steel work to take charge of tool drafting room for large stamping plant in Milwaukee; unusual opportunity for an ambitious and capable man; state salary and past experience. Box 166, AMERICAN MACHINIST.

SITUATIONS WANTED

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MASSACHUSETTS

A-1 foreman, machinist or toolmaker, now employed, desires position in Massachusetts on Connecticut. Box 349, AMER. MACHINIST.

Mechanical and civil engineer, with 17 years' shop, office and field experience, desires responsible position; heavy construction work preferred; high class man. Box 332, AM. M.

Wanted—Position as superintendent by man 49; was 10 years in last place, four in present; is a thorough mechanic of varied experience, well versed in all uptodate manufacturing methods and of producing duplicate parts; is a good executive. Box 327, AM. M.

MICHIGAN

Practical mechanic, who has been demonstrator, salesman and engineer for large machine tool company, also charge of equipment for one of the largest plants in the country, seeks salaried position in keeping with his experience with option of buying an interest later. Box 335, AMER. MACHINIST.

Position as general foreman or superintendent: 17 years' of practical and executive experience: an expert designer on all kinds of tools, dies and special machines: familiar with uptodate methods in all branches of manufacturing: first class organizer: employed at present: best of references. Box 330, AMERICAN MACHINIST.

NEW JERSEY

Machine shop foreman looking for a position; uptodate; a hustler; A-1 references. Box 352, AMERICAN MACHINIST.

Superintendent or foreman of wood pattern maker in all classes, heavy or light marine or stationary, with years' experience; best of references. Box 348, AMERICAN MACHINIST.

Draftsman, American, 26, seven years' shop and board experience, desires position with manufacturer or designer of automatic machinery. Box 353, AMERICAN MACHINIST.

NEW YORK

A machinist, first class, on vise, lathe, shaper, or all-around accurate worker, long experience, wishes position; forty years old. Box 344, AMERICAN MACHINIST.

First class detailer, 22, desires change; four years' experience on automatic and special machinery; shop experience; quick worker, accurate. Box 354, AMER. MACH.

Gear expert desires change; seventeen years' practical experience and theoretical knowledge of gear cutting; executive ability; references. Box 320, AMERICAN MACHINIST.

Foreman desires change, medium or heavy work; first class organizer piece work; uptodate on modern methods; electrical or general machinery; references from present employer. Box 339, AMERICAN MACHINIST.

A young uptodate toolmaker, 19 years' experience, first-class on all kinds of tools and experimental work, also held position as inspector and had charge, wish to make a change. Box 350, AMERICAN MACHINIST.

Superintendent or general foreman of machine shop or manufacturing, thoroughly competent mechanic on steam engine, pumps and gasolene engine, with 20 years' practical experience, expert in jigs and fixtures, like to change position. Box 328, AMER. MACH.

PENNSYLVANIA

Mechanical designer, technical education, experienced in developing inventions and automatic machinery; references. Box 340, AMERICAN MACHINIST.

Technical graduate, six years' theoretical and practical experience designing general machinery, automatic machines, structural work and plant designer, wants responsible position. Box 345, AMERICAN MACHINIST.

High grade tool designer desires change; now employed as chief tool designer; automatic and modern shop interchangeable practice; technical education; accurate, practical, progressive. Box 351, AMERICAN MACHINIST.

Mechanical engineer of sixteen years' experience, uptodate in modern shop practice, good organizer and systematizer, skilled in cost reduction and increase of output, desires position as engineer or superintendent. Box 302, AMERICAN MACHINIST.

WISCONSIN

Man of good education and wide practical experience, wants position as foreman of tool job, or on experimental work. Box 307, AMERICAN MACHINIST.

FOR SALE

For Sale—100,000 yellow brass disks, 15 gage, 3 inches in diameter; bargain. Stewart & Clark Mfg. Co., Chicago.

For Sale—Two bench power presses; drawing press, 3½-inch stroke; Kearney & Trecker universal milling machine, two 2-spindle drills. P. O. Box 407, Waterbury, Conn.

For Sale—Six pieces (total length 1075') 16" second-hand rubber and canvas composition conveyer belting, 5/16" thick, almost as good as new. Write for particulars. Oliver Chilled Plow Works, South Bend, Ind.

Second-Hand Machines for Sale—Planer, 36"x26"x8", Freeland; lathe, 12"x8' 6", Freeland; lathe, 14"x8' 6", Freeland; lathe, 12"x12". R. Hoe & Co.; snaping machine, 10" stroke, Freeland; keyway machine, Norton; No. 6 Sturtevant blower, swing grinder, L. Best. Box 347, AMERICAN MACHINIST.

For Sale—Machine shop equipment, modern machinery, used but little; four lathes, three drills, miller, keyseater, planer, Norton grinder, emery stands, good lot of small tools, electric motor; in good town of 20,000; favorable terms to parties having a good line to manufacture here. Box 36, Muscatine, Iowa.

An opportunity to start a machine shop; we offer one of our departments for sale, the one used to establish our business; it is small and profitable work, but as we are devoting ourselves to heavier work, we offer to sell for $2000, all the drawings, patterns, and stock of finished and partly finished parts and rough material (inventories over $3000), circulars, electrotypes, special machinery and fixtures, and an established trade. Address Sipp Machine Company, Paterson, N. J.

Talks With Our Readers

By the Sales Manager

Old prejudices cling. Like the barnacles on the ship's bottom, they impede progress but don't stop it.

There are folks in the world who believe that automobiles are the invention of the devil—there are horses, old enough to know better, who insist on climbing the fence every time one passes them.

Years ago, when business was done that way, some graybeards accepted things as they were and set up a principle of law which they called "CAVEAT EMPTOR." Put into plain English it means, "Let the buyer beware."

We don't know whether that still holds as a principle in law or not—it doesn't make any difference.

Nowadays, the *seller* has learned that if he tries to do business on that basis his next appeal to the law will be in bankruptcy proceedings.

Yet there are many people who still believe that the seller's first object is to "do" the buyer if he can and that advertising is the advance messenger heralding the coming swindle.

"Truth," says Dr. Charles W. Eliot, "is the new virtue."

Advertising is largely responsible for the place this "new virtue" holds in trade. Instead of doing business in the dark, we get into the light of publicity. Instead of playing a hold-up game in a dark alley when the moon goes behind a cloud, we come out on the brightest street and plant our wares where all may see.

There is no more potent selling argument for a good article than the truth about it.

There is no more disastrous experiment than juggling with the truth in an advertisement.

There is nothing so expensive as advertising goods that can't make good.

There is nothing better on earth that a manufacturer can have than a customer satisfied that the article lives up to the claims made for it—unless it be a few hundred more of the same customers.

That is why it pays to advertise good goods by telling the truth about them—and likewise why it doesn't pay to advertise poor goods in any way.

The purpose of advertising is to sell things, but in the process it must inform, interest, inspire and educate; it must knit buyer and seller in closer relationship, discover human wants and fill them, promote mutual confidence and spread the truth.

"Caveat Emptor?" Not when the seller prints his claims in plain language, circulates them broadcast, guarantees them—in short, not when he advertises.